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Electrical World

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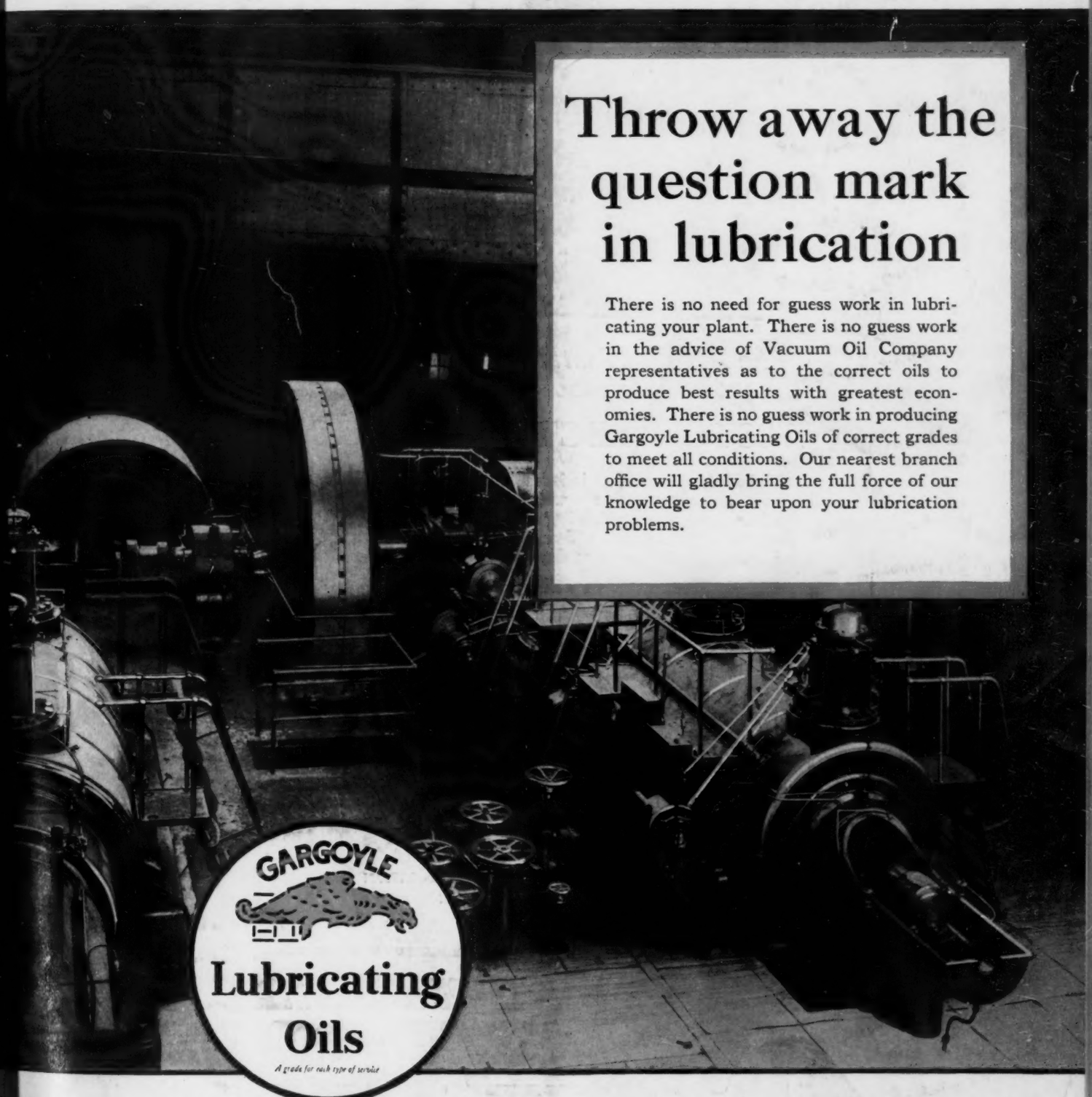
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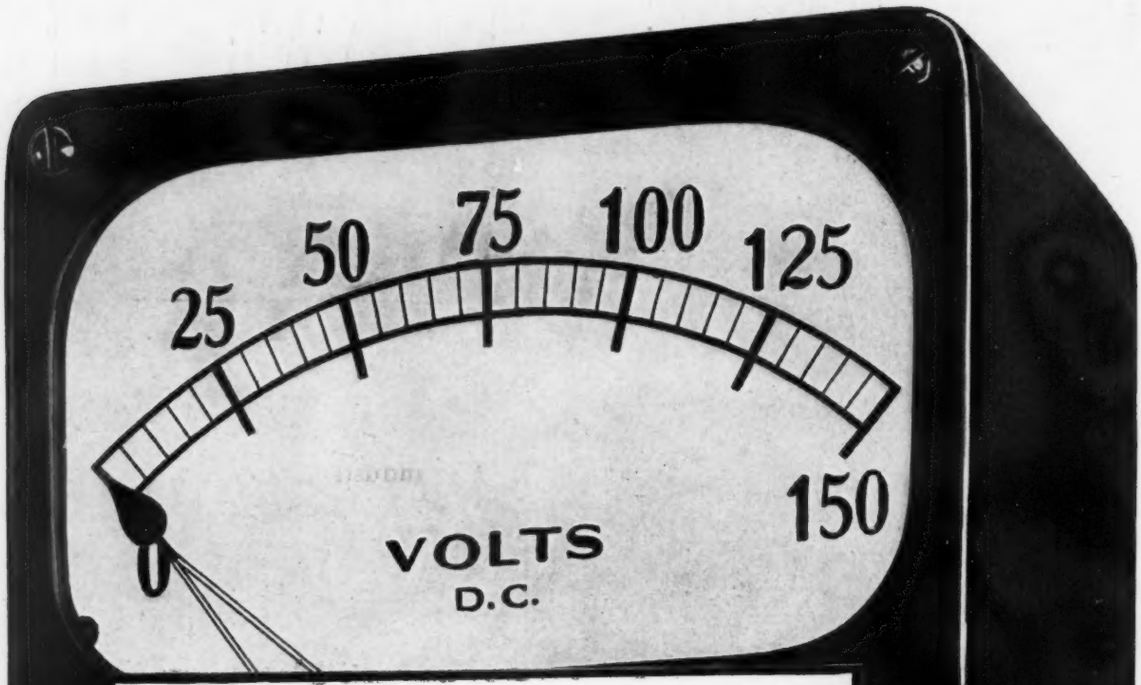

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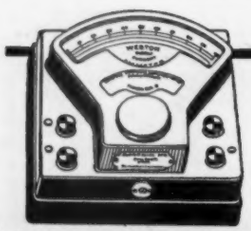

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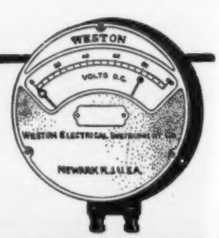

Electrical World

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W. H. ONKEN, JR.

Editor

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A Billion-Dollar Year

ELECTRIC light and power companies have raised $597,943,500 during the first six months of this year. This exceeds by $140,436,300 the money raised in the corresponding period last year and sets a record for utility financing in the same period of time. Indications thus point to financing to the amount of about $1,200,000,000 this year as against $982,420,800 last year.

Major financing this year was done in January, February and March, while last year the summer period was the outstanding one. A very large percentage of the new financing is for additions and extensions to properties, but the year has also witnessed a large amount of stock financing to acquire and consolidate properties. Money rates and yields are very favorable now and lower than in the past two months. Measured by a money yardstick, the industry is very prosperous and has a well-balanced financial foundation in senior and junior securities. Customer-ownership campaigns have gone over well, and dividend records are splendid. Despite a slight slump in certain industries, the light and power companies have continued to increase their volume of business and their facilities for handling new business.

A Remarkable Gain Recorded in Station Performance

ALL engineers concerned with the development of power stations may well feel proud of their work. The splendid report of the Institute committee, printed in this issue, shows a gain of more than 20 per cent in the thermal economy of stations during the past year. In addition, it may be noted that these engineers have a definite program for reducing capital costs and improving efficiencies to a still greater degree.

No similar improvements in transmission and distribution can be recorded. Despite the development of apparatus to a high degree of efficiency, more than 30 per cent of the energy generated is wasted in transmission and distribution losses. Moreover, capital costs of this part of the system are increasing very rapidly, and it is questionable whether the reliability or quality of service in metropolitan systems has been improved to any great extent in the past decade.

The accomplishments of station engineers in the face of predictions made a few years ago in regard to possible station improvements indicate that splendid opportunities exist for real engineering developments in transmission and distribution. Nor is it by any means necessary to go to overhead or underground lines of extremely high voltage to bring about the improvements. What is needed is initiative and daring in system planning and the use of new methods in transmission and distribution. If in modern power plants fuel costs are now only about 30 per cent of switchboard energy costs, there appears to be reason for making more economical layouts of transmission and distribution lines to reduce losses and decrease investments. A 30 per cent gain in transmission and distribution efficiency would be an accomplishment of the highest merit, and it is to be hoped that the achievements of the station engineers will spur developments in these fields also.

Engineers Record Progress and Discuss Problems

THE Saratoga Springs convention of the American Institute of Electrical Engineers was notable for three things. It set a milestone as regards the quality of technical committee reports; technical papers were presented that were splendid in their reflection of current problems and record of major developments, and two evening meetings were held which gave evidence of the breadth of engineering thinking. The reports of the technical committee chairmen consisted of well-digested summaries of developments, a discussion of current problems and a program for future work. These reports are all well worth reading, and some of them are outstanding contributions to the progress of the art.

In the technical program the distribution problem, the oil-breaker problem and the cable problem continued to cause the greatest interest and discussion. In the selection of the best secondary distribution system much remains to be done. Representatives from several properties advocated different systems and disagreed greatly. Some of the disagreement was based on local conditions and the assumptions made in the analysis, but there remains much to be explained and to be done before any system proves its case convincingly.

The oil-breaker situation from the standpoint of the operator is still unsatisfactory. Many old-type breakers are in use and are inadequate on systems which have grown rapidly, and it is a major job to meet this kind of situation. On the other hand, evidence was submitted showing that new types of breakers were very greatly improved in that circuit arcs could be cleared in half a cycle. The American engineers also expressed disapproval of the European practice of increasing the time of relay settings to relieve the duty of breakers. This saves the breakers at the expense of the service and is a step in the wrong direction.

Cable developments are under way, but very little new progress can be recorded as an accomplished fact for high-voltage power cables. As brought out at the meeting, a development such as the permalloy cable for telegraphy would be very much welcomed. Yet several high-voltage cables have been ordered, and well-organized research is bearing fruit.

The great value of Institute meetings, which are about the only open forum for engineers in the indus-

try, lies in the discussions. The recent meetings were notable for the discussions of the papers and reports by operating and design engineers, who showed a perspective and a grasp of their subject which promise well for the future of the industry. The Saratoga convention was a splendid addition to the long series of meetings of the Institute.

A Gas Man's Comments Upon Electrical Women's Work

ONE of the most prominent men in the gas industry was in attendance at the recent convention of the National Electric Light Association in San Francisco. He is the chief official of one of the great metropolitan companies. In commenting upon the presence of more than a dozen young women on the program of the Public Relations Section one afternoon, he made this impressive statement: "I am particularly struck with this part which women are playing on this program and the manner in which they are entering into the public relations work of the electric light and power industry. I congratulate the N. E. L. A., but frankly as a gas man it frightens me. You are building up a new bond between your industry and your customers of such an intimate nature that it will be of tremendous strength and influence for good."

No man could have listened to these young ladies, representing utilities in all parts of the country, without recognizing the deep significance of their work. Their seriousness, their earnestness and their ability to tell their story were vivid proof of their value to the industry. And many an executive has gone home with a new insight into the expanding place of women in the organization of the modern central station.

Parallel Convention Sessions Cost Too Much

NOW that the tumult is over and the captains and the kings are home again, there is one question, raised again and most emphatically at the big N. E. L. A. convention, that should be pondered further. What can be done to prevent in future the program conflicts that so bedeviled the commercial men this year? Parallel sessions of the Public Relations and Commercial Sections, appealing as they do directly to the same class of men, set up an impossible situation this year. The crowd went to the commercial meeting on Tuesday and to the public relations meeting on Wednesday and to a degree on Thursday, and each time was forced to sacrifice a program in the other room that was full of meat and profit and deserved attendance. Each day one section was bitterly disappointed and hundreds of men were prevented from participating in programs that they had gone thousands of miles, to sit in on.

But the principle goes further than that. Is it the desire to upbuild well-balanced executives in the electric light and power industry who understand their business from all sides, or is it the desire that the technical, commercial or accounting men shall know nothing of the problems of the other branches? Public relations permeates all phases of the business today, and it would be of substantial benefit if every man who attends a convention of the National Electric Light Association could absorb the spirit and the substance of this ubiquitous phase of modern public administration. It would be no less valuable if the engineer could know somewhat more deeply the purposes and aspirations of the sales department and if the commercial man could appreciate better the conditions of the technical man's job. One of the things which the N. E. L. A. meeting should do for them, it would seem, is to give them this broader contact and vision and send each one back home with a larger conception of his functions and his responsibility.

The N. E. L. A. is worth all that it costs in money and in time—and more. It is worth it to the electrical industry and to the American public. Some way must be found, however, so to organize the program that each one of the four sections shall have its orderly turn to hold the center of the stage and present its chief problems and its aspirations to the entire industry. The program this year was a great achievement. There has never been a greater convention in any industry. The further opportunity is to bring under the inspiration of its constructive teaching all men who attend by concentrating on the vital themes of each section before the entire audience.

The Nature of Electrical Conductivity

THOSE who attempt to keep reasonably abreast of the progress of electrical research have become more or less accustomed in these latter days to feelings of confusion, if not of helplessness, when confronted with the mixtures of metaphysics and mathematics apparently essential for a proper understanding of such theories as those of energy quanta, relativity and the various types of atomic model. They are apt to turn with relief—those who must still concern themselves with the science of engineering—to some of the older, more firmly established and apparently simpler electrical phenomena, with the feeling that in them at least one can see their effects, reproduce them and even, by useful analogies, think one understands them.

Consider the phenomenon of electric conductivity, for example. Certainly so far as electrical engineers are concerned its laws are of the simplest character, and they apparently admit approximate explanation in terms of almost any fundamental conception of the nature of the movement of electricity. But when one considers it more closely and attempts to extend any one of these fundamental conceptions outside the limited range of conducting materials commonly utilized by engineers, one is again confronted by a vast array of conflicting facts which will soon upset any theory of the nature of conductivity that one may attempt to apply. Turning to the physicist for help, it is soon realized that confusion and helplessness are quite as great as before, and one is astonished to find that all the intimate knowledge recently acquired as to the structure of the atom has done little or nothing to clarify so simple and basic a phenomenon as that of electrical conductivity. For it must be understood that in attempting to examine the ultimate nature of conductivity it is necessary to extend one's view far beyond the range of metallic conductors used by engineers and to take into due consideration the conducting properties of all the elements. Engineers are accustomed to divide all materials into conductors and insulators. Most of them realize, however, that this division is a rough one only and that many substances fall into the intermediate region. Physicists consider

all materials from the standpoint of any one property and have shown that in the matter of electrical conductivity there is a wider range of value among all known substances than pertains to any other known physical property. The range of conductivity among metals, say from silver to bismuth, is seventy-five to one, but that between silver and sulphur is in the ratio of 10^{21}! Within this stupendous range it is possible to find almost any abnormality of electrical conductivity as affected by external agencies.

While the conductivity of metals decreases with increasing temperature, that of the so-called insulators, and even of some fairly good conductors, decreases. Further, while the increase of metallic conductivity with decreasing temperature is linear through the normal range, it has been learned in recent years that at extremely low temperatures in the neighborhood of absolute zero the conductivity actually becomes infinite in value; that is, the resistance falls to zero. A current set up by magnetic induction in a coil of lead or mercury, in the neighborhood of 4 deg. absolute, is said to continue indefinitely. The anomalies appearing under the influences of pressure, tension and other external agencies are numerous and quite definite, and apparently without relation as compared with other properties of the materials. Some idea is possible, therefore, as to the difficulties of developing a satisfactory theory to explain electrical conductivity on the basis of what must now be definitely accepted as the fundamental feature of any theory; that is, the motion of electrons. A number of such theories have been proposed, and all cause greater or less degrees of complexity to arise in efforts to account for all the inconsistencies of behavior mentioned above. No one of them is more than approximately satisfactory, and the engineer is left with the realization that even one of the simplest of laws invoked by the electrical engineer is merely one outcropping of nature's amazing structure in which values are within a useful range and the behavior within that range fairly uniform.

Proper Home Lighting Will Bring Enormous Business

FOR years in most places residence lighting has been permitted to drift along. Doubtless many of those variously interested in its improvement may think they have exerted much effort. Nevertheless, if one looks at the results of a detailed survey of the wiring and lighting equipment in average wired homes and weighs the conditions against what they should be if a home is to be properly lighted even from a utilitarian viewpoint, great possibilities are seen still to lie ahead. Conservative computations, based upon a recent survey, indicate that about one million dollars' worth of wiring and lighting equipment must be sold for each group of five thousand homes now wired before they can be properly lighted from purely a utilitarian viewpoint. This is equivalent to about $50 per person or approximately $200 per home. Here is an easy means for any one to compute the business available in the homes which are already wired in any community in order that these wired homes may be brought up to a proper utilitarian standard of lighting. Then there still remain the business waiting in unwired homes and also that represented by the extensive possibilities of decorative lighting.

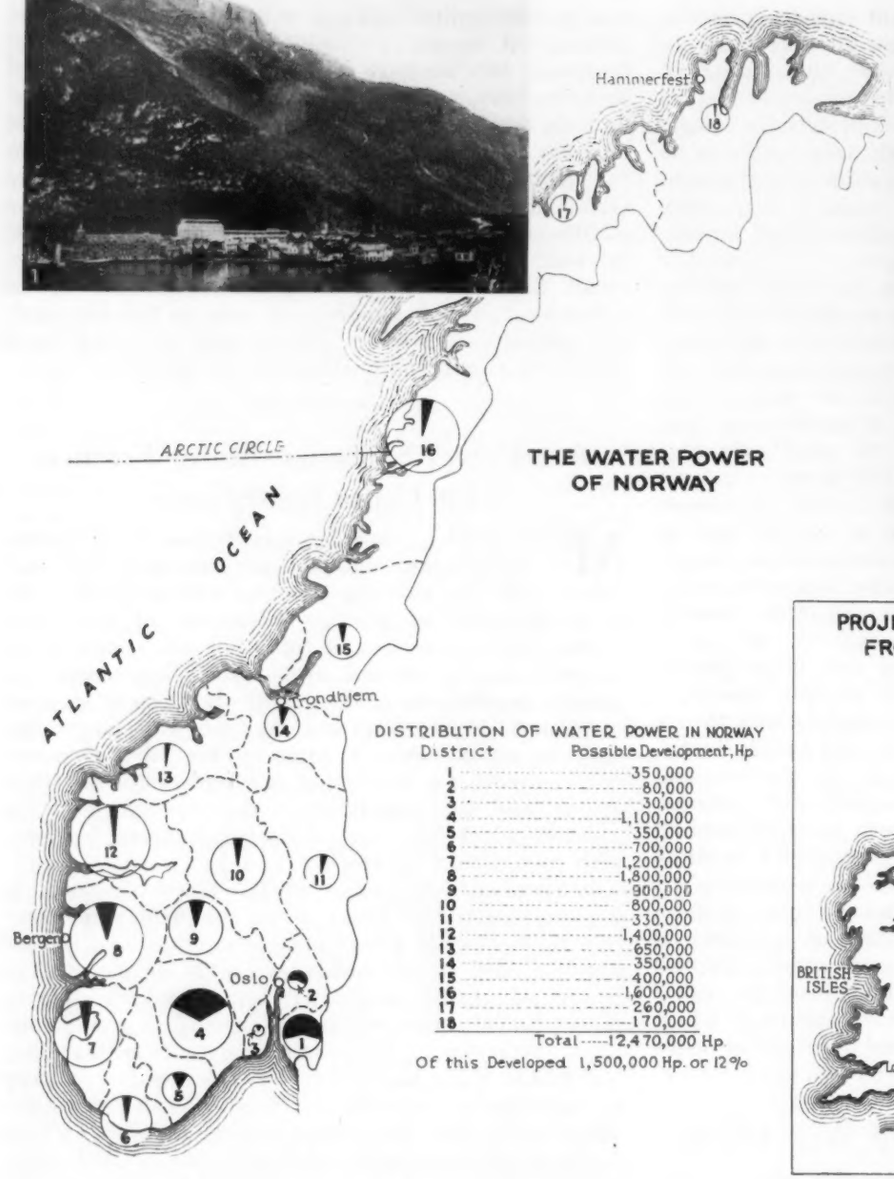
A conservative estimate of the increase in central-station revenue when the present wired homes are equipped for proper lighting is $13 per year per home. Actually it would probably be considerably more. Obviously this increase is almost entirely clear profit. To bring the wired homes in a city of 100,000 population up to this conservative ideal at least $2,000,000 must be spent for portable lamps, at least $1,000,000 for utilitarian wall brackets, at least $1,000,000 for replacing obsolete ceiling fixtures, at least $500,000 for additional convenience outlets, and at least $500,000 per year for additional electrical energy. The minimum result for the central-station company would be an increase of several hundred per cent in the net profit per residential customer. Surely these are commercial possibilities sufficiently attractive to go after.

Are Power Salesmen Being Trained for Other Industries?

MANY utility companies report that the activities of their power salesmen are becoming less concerned with the shutting down of private plants—the great majority of possible customers of this class having been secured—and that they are giving more attention to the internal problems of their customers and the possibilities of developing the loads of existing customers. Much good can come from what may rightfully be called research work on the part of power salesmen both for developing new outlets for electrical energy and for consolidating and strengthening the position which the central-station company occupies with its existing customers.

It frequently happens that the power salesman in working out the problems of his customer which pertain to the use of power must also study and become familiar with all the processes of his customer. The power salesman's familiarity with and knowledge of the customer's requirements may come so prominently to the attention of manufacturer executives that they will find in him a man whose services would be valuable to their own organization. It is not unusual, when this discovery is made, for a manufacturer to acquire a good engineer and the power company to lose a good power salesman. In fact, many companies have found that they have trained men to become specialists in certain industries only to lose them to these same industries. Similar situations frequently arise between the power salesman and the manufacturer of electrical equipment, who finds in the utility salesman a man who knows power equipment and its applications better than many of the manufacturers' own representatives, with the result that the power salesman becomes the manufacturer's representative.

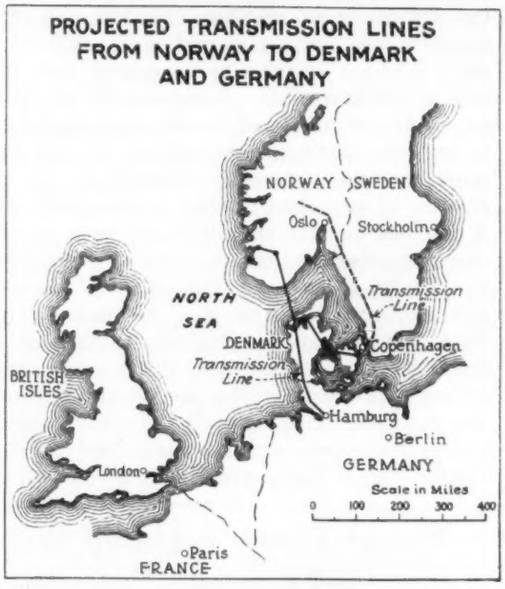
It cannot be denied that the presence among the customers of a power company of men trained in the utility business is beneficial to the power companies and to the extension of central-station service. It may also be said that a power salesman who has become so well trained in the application of power to a specific industry that he is worth more to a manufacturer in that industry than the amount he is being paid by the utility is still worth more to the utility than to the manufacturer. The sales engineer is worth more to the company that trains him than to the company that takes him away. Few companies can afford to lose a power salesman of the real sort for what it would cost to keep him, as the expense of training a new man is generally much greater than the added expense of keeping a good man.



DISTRIBUTION OF WATER POWER IN NORWAY

District	Possible Development, Hp
1	350,000
2	80,000
3	30,000
4	1,100,000
5	350,000
6	700,000
7	1,200,000
8	1,800,000
9	900,000
10	800,000
11	330,000
12	1,400,000
13	650,000
14	350,000
15	400,000
16	1,600,000
17	260,000
18	170,000
Total	12,470,000 Hp.

Of this Developed 1,500,000 Hp. or 12%



"White Coal" Makes Norway Prosperous

NORWAY has about 12,500,000 hp. of potential hydro-electric power, most of it of the high-head type, in the deep fiords along the west coast. About 1,500,000 hp., or 12 per cent of this total, is now developed for the use of the 2,500,000 people.

The fiords cut deep into the mountains, and it is usually possible to build the power house and tailrace at tide level so that ocean steamers can run up to the power house and the nearby factories.

While industries such as the manufacture of aluminum and the production of atmospheric nitrogen are developing rapidly, there is such an abundance of power that plans are under consideration for transmission lines to Denmark and Germany. One route would be through Sweden and across comparatively narrow straits to Copenhagen, a total distance of 550 miles, and the other to Denmark, using a sea cable, a distance of 350 miles.

American Power Stations*

Lead the World in Fuel Economy—Trend Toward Reduction in Operating and Investment Costs—Details of Station Developments

THE past year has witnessed the actual generation of power in an 80,000-kw. generating station at a coal rate per kilowatt-hour 20 per cent lower than any previous performance on a commercial scale. May we with confidence look forward to further gains of the same magnitude? May we expect that each new station built will establish a new record for operating performance? Why does each new steam-generating station differ so radically from those already built? If we are to answer these questions, we must evaluate the present-day tendencies, look backward a bit to see how far we have come, and attempt to look forward. Important technical achievements of the last year have been:

1. The operation of the two 40,000-kw. General Electric single-cylinder turbines in the Philo station of the Ohio Power Company. The steam is delivered to the turbine throttle at a pressure of 550 lb. per square inch gage and a temperature of 725 deg. F., the steam being withdrawn from the turbine after being expanded down to a gage pressure of 155 lb., returned to the boiler room, reheated to a temperature of 725 deg. F., and then expanded through the remaining stages of the turbine to a pressure of approximately ½ lb. per square inch absolute at the turbine exhaust. This marks the consummation in this country of Ferranti's dream of a reheating cycle. The two units in this station have been in operation since Oct. 14, 1924, and Feb. 24, 1925, respectively. The water rate, corresponding to a load of 40,000 kw., steam conditions being as indicated above and no steam bled from the turbine for feed-water heating, is reported to be approximately 8 lb. per kilowatt-hour. In normal operation, steam is bled from two stages of the turbines for feed-water heating. The feed water then goes through economizers before being delivered to the boilers. The air for combustion passes through a preheater before going to the wind box of the chain grate stoker. The flue gases pass through the preheater on their way from the economizers to the stack. The heat consumption for this station over a week's time has been as low as 13,715 B.t.u. per kilowatt-hour of net station send-out, this performance corresponding to a load factor of 81 per cent for the week.

2. The initial operation of the Crawford Avenue station of the Commonwealth Edison Company in Chicago. The turbines in this station are designed for substantially the same steam conditions as are the turbines in the Philo station. The three turbines in the Crawford Avenue station are of the cross-compound type and were built by three different manufacturers: (*a*) 60,000-kw. unit, General Electric Company; (*b*) 52,000-kw. unit, Westinghouse; (*c*) 50,000-kw. unit, C. A. Parsons. Two surface condensers with vertical tubes connect direct to the exhaust casing of the low-pressure element of each of these turbines. Each of these three turbines was built on a design and they present many interesting features. Due to the new design of low-pressure exhaust nozzle and condenser, new features have been embodied in the turbine foundations, the building layout and the arrangement of auxiliaries. The Crawford Avenue station has been in operation only a few months and as yet the single stage of reheating of the steam during its expansion has not been used.

3. The construction by the General Electric Company of a 3,000-kw. turbine, running at 3,600 r.p.m., for operation in the Weymouth station of the Edison Electric Illuminating Company, with a steam pressure of 1,200 lb. per square inch gage and a steam temperature of 700 deg. F. at the turbine throttle. This turbine will exhaust against a back pressure of approximately 350 lb. per square inch gage, its steam being first returned to the boiler room to be reheated to 700 deg. F. and then discharged into the main steam header of the station. Only one boiler for operation at 1,200 lb. per square inch gage has been installed at the present time. This high-pressure boiler and the turbine which serves as its reducing valve will soon be completely erected and ready for operation.

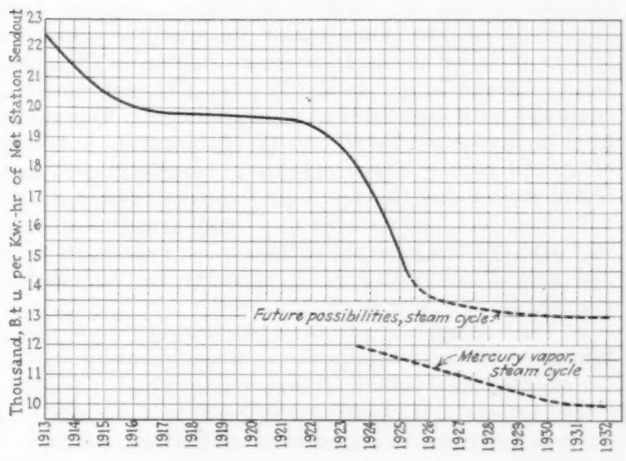


FIG. 1—TREND OF PERFORMANCE OF STATIONS

The great advances in American station performance may be visualized by reference to the curves in Fig. 1, which show the trend of performance of typical stations plotted against the dates of initial operation of these stations. This curve is not the product of a disordered imagination, but represents the weighted average in connection with the performances plotted for twenty-two stations. At first glance the curve appears to have a very peculiar shape. Further analysis indicates that there was a very definite reason for the slowing up of power-station development during the war period, and the extremely high prices of coal during the period from 1920 to 1922, inclusive, in no small measure account for the marked improvement in the performance of stations which have gone in service within the last six months.

The dotted extension of the curve shown in Fig. 1 is our estimate as to the future possibilities in the way of improved performance for a station designed to operate on the straight steam cycle with a single stage of reheating. Obviously, this curve has to flatten out. There is also shown the over-all performance for a combined mercury vapor and steam station, which is indicated by the performance of the mercury vapor turbine and boiler in the Dutch Point station of the Hartford Electric Light Company, and there is shown by means of a dotted curve an estimate as to the future possibilities of the combined mercury vapor and steam cycle.

*Abstract of annual report of committee on power generation, Vern E. Alden, chairman. Presented at A.I.E.E. convention at Saratoga Springs, N. Y., June 22-26.

4. The operation in the Colfax station of the Duquesne Light Company, in Pittsburgh, of two 35,000-kw. Westinghouse turbines, with four-stage bleeding of steam to raise the feed water to a final temperature of approximately 350 deg. F. before it is returned to the boilers. This marks the extreme development of the regenerative cycle in turbine room operation.

5. The operation of four 30,600-sq.ft., double-ended Stirling boilers, with 22,464-sq.ft. economizers, in the Lake Shore station of the Cleveland Electric Illuminating Company. These boilers and economizers, equipped with pulverized fuel burners and furnaces, each of the latter having a volume of 29,150 cu.ft., have shown on test an efficiency of 92.9 per cent at 140 per cent of normal rating and an efficiency of 89.8 per cent at 270 per cent of normal rating. These same boilers have operated at an average gross efficiency of as high as 90.4 per cent for a month's time. These results have been obtained with coal running as high as 11 per cent in ash and as low as 12,600 B.t.u. per pound in heat value. The sulphur was as high as 3.5 per cent and the coal ash melted at approximately 2,150 deg. F.

Operating efficiencies in connection with the 29,085-sq.ft. double-ended Stirling boilers in the Trenton Channel station of the Detroit Edison Company have been only slightly lower than the results quoted for boilers installed in the Lake Shore station in Cleveland. Each of these boilers in the Trenton Channel station is equipped with two 9,492-sq.ft. economizers. The coal is fired in pulverized form, and the furnace has a volume of 25,140 cu.ft. These operating results in the Lake Shore station and the Trenton Channel station, with the unburned fuel loss reduced to a small fraction of 1 per cent and the temperature of flue gases reduced to from 230 deg. F. to 250 deg. F., present an achievement undreamed of a few years ago.

6. The operation of the 18,010-sq.ft. Babcock & Wilcox cross-drum boilers in the Cahokia station of the Union Electric Light & Power Company of St. Louis. These boilers are twenty tubes high in the main tube bank and are not equipped with economizers. The coal is burned in pulverized form. The furnace has a volume of 12,850 cu.ft. Burning a most inferior grade of southern Illinois coal, these boilers have shown on test an efficiency of 85.9 per cent at 148 per cent of normal rating and an efficiency of 82.1 per cent at 260 per cent of normal rating. The average gross boiler room efficiency in the Cahokia station has run as high as 81.2 per cent over a month's time. These results are remarkable for two reasons: (*a*) They were accomplished with very low-grade coal. (*b*) They were accomplished without the use of economizers or air heaters.

7. The successful operation in the Chester station of the Philadelphia Electric Company of underfeed stokers, with air delivered to the stoker wind box preheated to a temperature of 550 deg. F. A 15,000-sq.ft. boiler, equipped with a fifteen-retort, twenty-two-tuyère Taylor stoker with clinker grinder, has operated for extended periods at ratings in excess of 300 per cent of normal boiler rating, with air delivered to the stoker wind box at a temperature of approximately 550 deg. F. The fuel bed has been free from large clinkers and is as easy to maintain in good condition as in connection with other boilers not equipped with air preheaters. It appears that stoker maintenance will not be greatly increased by use of preheated air. It does appear, however, that furnace walls designed along conventional lines will not withstand the effects of the high furnace temperatures that obtain in connection with the use of preheated air.

8. The further developments in use of water-cooled furnace side walls as exemplified in connection with the boilers installed in the Hell Gate station and Sherman Creek station of the United Electric Light & Power Company in New York and the boilers installed in the Milwaukee station of the Consumers' Power Company in Michigan. A novel wall has been in operation since November in connection with one of the stoker-fired boilers in the Lake Shore station in Cleveland. By water cooling, the inner refractory lining having a thickness of less than 1 in. is maintained at a temperature of less than 2,000 deg. F., but still at not too low a temperature to slow up combustion adjacent to the wall.

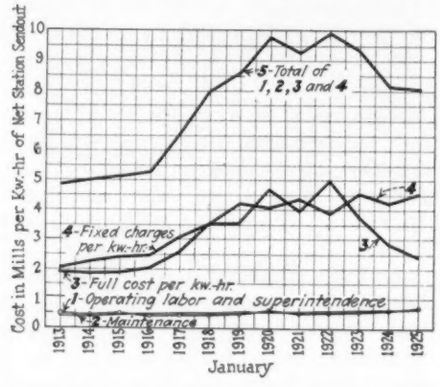


FIG. 2—TREND OF STATION COST

In Fig. 2 there is shown the trend of operating costs and fixed charges of typical large power stations plotted against the dates of initial operation for these stations. As in connection with Fig. 1, only power stations of 60,000-kw. capacity and higher are considered. The committee has endeavored to take into account all the different factors in the derivation of these curves. Some of these factors are as follows:

1. The variation in the cost of labor, for operation, maintenance, and construction work during the period from 1913 to 1925.
2. The variation in material costs and equipment costs.
3. The variation in coal prices (costs of coal delivered in the bunker for a power station in Baltimore has been taken as the basis).
4. The variation in the cost of new money in connection with financing which has been done during succeeding years.
5. The variation in taxes which have as their basis the investment in power stations.
6. The variation in the probable use factor of equipment placed in service during succeeding years. The average load factor of the system, the outages of equipment for inspection and repairs and the amount of spare capacity considered necessary are factors which go to make up the use factor in connection with the station.
7. The decrease in man-hours of operating labor per kilowatt-hour incident to certain developments in power station design.
8. The tendency toward the decrease in cost per kilowatt of installed capacity due to certain trends of power station design, and the conflicting tendency toward increased power station costs due to other trends of power station design.

9. The successful use of Cottrell precipitators in the Trenton Channel station of the Detroit Edison Company for the removal of fine ash from the flue gases before they pass out of the stack. The ability of this equipment to remove 75 per cent of the solids in suspension in the flue gas has been demonstrated.

10. The successful operation of the 70-in. Fuller air-separating type of pulverizing mill in the Cahokia station of the Union Electric Light & Power Company of St. Louis. This mill has pulverized 28 net tons of Illinois coal per hour, with a combined power consumption of 294 kw. for the motors driving the mill and the exhauster fan. Coal was pulverized to a fineness so that 65 per cent passed through a 200-mesh screen. This mill and its driving motor occupy a floor space of 13 ft. x 21 ft.

11. The development by the Fuller-Lehigh Company of the "well type" furnace for burning coal in pulverized form. In an experimental furnace 8 ft. square

x 8 ft. high 32,700 lb. of coal per hour has been burned. Such observations as can be made in connection with a furnace open at the top to atmosphere indicate that the coal is completely burned.

12. The successful operation in several stations of automatic combustion control equipment. Notable installations are those in the Lake Shore station in Cleveland, Sherman Creek station in New York, and Devon station of the Connecticut Power & Light Company, in Devon, Conn. The close agreement between average monthly operating efficiencies in the Lake Shore station and the efficiencies obtained under the most carefully made tests have already been referred to. It appears that we now have available equipment that will enable us in large measure to eliminate the losses incident to the lack of constant vigilance by the firemen.

13. The efficient operation of large single-pass condensers in the Waterside station of the New York Edison Company and the Trenton Channel station of the Detroit Edison Company. In these installations less than 1 sq.ft. of surface is installed per kilowatt of turbine capacity. Ample provision has been made, however, for the pentration of steam into the tube bank. These installations point the way to possible reductions in the cost of condensing equipment without appreciable reductions in station economy.

14. The placing in operation of five 30,000-kw. and nine 20,000-kw. turbines of the new Westinghouse multi-exhaust Baumann type.

15. The construction by the General Electric Company of two 50,000-kw., 62,500-kva., 1,800-r.p.m., tandem compound turbo-generators for the new Richmond station of the Philadelphia Electric Company, and two 60,000-kw., 60,000-kva., 1,500-r.p.m., single-cylinder turbo-generators for the Fourteenth Street station of the New York Edison Company.

16. The use of three new methods for insuring the reliability of the power supply for the auxiliaries in large steam stations: (*a*) In ten new stations recently placed in operation or now in the course of construction the generator which supplies power for the essential auxiliaries is directly coupled to the main generator and driven by the main turbine. (*b*) In the Trenton Channel station of the Detroit Edison Company the power for the auxiliaries is obtained from separate turbo-generators which operate as condensing machines and constitute a separate power plant within the larger power plant. (*c*) In the Crawford Avenue station, Chicago, and Richmond station, Philadelphia, the power for the essential auxiliaries is to be obtained from a transformer which is tied direct to the leads of the main generator.

17 The extensive use of waste heat driers and steam driers for removing the moisture from coal before it is pulverized. This is best exemplified by the installations in the Cahokia station, in St. Louis, and the Trenton Channel station, in Detroit.

OTHER RECENT DEVELOPMENTS

These things have come to pass within the last year. Looking back over a slightly longer period, we see the development of the steel tube economizer for high-pressure installations; the development of the interdeck and radiant heat superheaters; the development of the air-cooled furnace for pulverized fuel, with a water screen for protecting the furnace floor; the development of the air preheater; the use of the closed system of ventilation with radiator type coolers for large turbo-generators; the widespread use of deaërators and evaporators; the all but universal swing to the use of electric-driven auxiliaries; the newer developments in the design of boiler settings for chain grate stokers to insure a thorough mixing of the rich gas stream which rises from the front end of the stoker with the excess air which comes up through the rear end of the stoker, so as to enable a minimum of excess air to be used; and the development of the underfeed stoker for total furnace depths up to 19 ft. 8 in. All of these things were unknown as commercial achievements and most of them undreamed of five years ago.

The length of the strides we have taken may be visualized by reference to the most interesting address delivered by W. H. Patchell at the time of his inauguration as president of the British Institution of Mechanical Engineers on Feb. 21, 1924. As a result of a review of the situation in this country and abroad, Mr. Patchell presented the operating efficiencies for thirty-six stations in England, twenty-five stations in the United States and one station—the Gennevilliers station —in France. The heat consumption per kilowatt-hour for the most efficient station in England was given as 20,150 B.t.u. The heat consumption for the most efficient station in the United States was given as 18,030 B.t.u., and the heat consumption for the Gennevilliers station in Paris was given as 22,240 B.t.u. We have referred earlier in this report to the remarkable performance of the Philo station of the Ohio Power Company, which has been as low as 13,715 B.t.u. per kilowatt-hour.

FUTURE POSSIBILITIES

One might well gain the impression that the possibilities for further improvement in steam station design have been almost exhausted. This fact is hardly the case. We have at least three major possibilities immediately ahead of us which will result in higher operating efficiencies for our steam-generating stations:

1. The further development of commercial equipment for use in the application of the mercury vapor-steam cycle.

2. The development of superheaters, high-pressure steam piping, valves and turbines for operation in connection with steam temperatures of 800 deg. F. or higher.

3. The use of hydrogen or some equally suitable gas as the cooling medium in connection with closed ventilating systems for turbo-generators, and the development of new generator designs that will take advantage of all the possibilities of this new cooling medium.

It is perfectly true, however, that whereas we have dropped from approximately 18,000 B.t.u. per kilowatt-hour to 14,000 B.t.u. per kilowatt-hour in the least eighteen months, we cannot look for a further reduction from 14,000 B.t.u. to 10,000 B.t.u. per kilowatt-hour unless we go to the use of the mercury vapor-steam cycle, with comparatively high pressure used in connection with the mercury vapor boiler and the most efficient possible layout in connection with the steam end of the station. As far as further reduction in the fuel cost in connection with our large steam stations goes, we are working on the law of diminishing returns, and we have already arrived at the point where further returns are going to be very difficult of attainment.

COSTS AT PRESENT

The real function of power station engineers is to deliver power on the station busbars at the lowest pos-

sible cost per kilowatt-hour, and it is in the analysis of the elements that go to make up the cost per kilowatt-hour that we find the real answer as to the most profitable trend for future power station development.

The total cost of each kilowatt-hour delivered on the station busbars is made up of four major elements: 1. Operating labor and superintendence. 2. Maintenance. 3. Fuel cost. 4. Fixed charges on the investment. The so-called operating costs are made up of items 1, 2 and 3. Accounting systems commonly used do not spread fixed charges so as to allocate so many mills to each kilowatt-hour generated, and accordingly many of us lose sight of them. It is perfectly obvious, however, that the interest and the taxes paid in connection with an investment in power stations and the money that must be set aside each year to provide for renewals due to depreciation and obsolescence are just as tangible elements entering into the cost per kilowatt-hour as the money which we must pay for fuel to generate that same kilowatt-hour.

The thing that stands out from an inspection of the curves in Fig. 2 is the relative trend of the fuel cost and the fixed charges during recent years. There has been a marked reduction in fuel cost due to the improvements in power station design and due to the declining price of coal. There is a definite upward tendency, however, in connection with the fixed charges per kilowatt-hour, and as the matter stands at the present time the fixed charges are 4.5 mills per kilowatt as compared with a fuel cost of 2.4 mills per kilowatt. For those stations that are located in closer proximity to the coal mines and have the advantage of lower coal costs, the fuel costs will be still further reduced, assuming, of course, the same modern power station design for the best possible economy. The fixed charges, however, will remain at 4.5 mills.

The indications are that if we strive for lower fuel costs by the use of more efficient stations, the fixed charges per kilowatt-hour will rise still higher, and the increase in fixed charges per kilowatt-hour will more than offset the decrease in fuel cost per kilowatt-hour.

The real job the power station engineer has ahead of him is to decrease the fixed charges per kilowatt and to re-establish the proper balance between fuel costs and fixed charges.

Certain executives and engineers will, no doubt, state that the fixed charges per kilowatt-hour in the newer stations which they are placing in operation are very much lower than the curve indicates in Fig. 2, this being for the reason that these newer stations are carrying the base load for their system and are operating at an extremely high use factor. Our answer is that this is a transient condition. Each new turbine or station operates on base load only for so long a time as it constitutes the most efficient turbine or the most efficient station generating power for that particular system.

Data compiled in 1923 by the turbine and generator committee of the Association of Edison Illuminating Companies showed that the generating unit is heavily loaded during the second and third years of its life, but that from then on the loads carried during succeeding years gradually decline. These data constituted the actual operating history as regards kilowatt-hours generated during succeeding years by 268 turbines ranging in size from 750 kw. to 60,000 kw. It is perfectly obvious that fixed charges per kilowatt-hour must be determined by taking the total fixed charges on a piece of equipment or on a station during its life and spreading them over the total number of kilowatt-hours generated by that particular turbine or station during its useful life.

It is of interest to note from these data that the average unit capacity factor during the seventeen-year period on the 268 turbines was approximately 25 per cent. The curve of fixed charges given as a part of Fig. 2 was based on the assumption that for generating stations placed in operation in 1913 the average unit capacity factor during their life would be 31 per cent and for stations placed in operation in 1925 the average unit capacity factor would be 36 per cent. The evidence would tend to indicate, therefore, that if we have erred it is on the side of showing the fixed charges per kilowatt-hour too low rather than as too high.

TRENDS OF DESIGN

Tendencies in the design of steam-generating stations may be classified under four heads:

1. Tendencies which improve the reliability of the power station, increase its cost, but do not appreciably affect the operating efficiency; for example: (*a*) The use of house turbines, auxiliary generators, and storage batteries for insuring the auxiliary power supply. (*b*) Isolated phase layout and the use of reactors and other protective devices in the switchhouse. (*c*) The duplication of auxiliaries, and provision of excessive amounts of spare capacity in boilers and turbines.

2. Tendencies which decrease the coal consumption per kilowatt-hour and increase the cost of the power station; for example: (*a*) The use of excessively high steam pressure taken together with a single stage of steam reheating during its expansion. (*b*) The use of pulverized fuel-burning equipment. (*c*) The use of variable speed motors for driving auxiliaries where saving in power consumption at light loads is the consideration. (*d*) The use of air heaters or economizers usually falls in this classification. (*e*) The use of an excessively large amount of surface in the surface condensers for the main turbines.

3. Tendencies which decrease the coal consumption per kilowatt-hour and also result in a reduction in the cost of the power station and perhaps in the cost of operating labor; for example: (*a*) The use of electrically driven auxiliaries. (*b*) The use of moderately high steam pressures without reheating. (*c*) The use of the highest steam temperatures that are possible with existing materials. (*d*) The use of large turbines and large boilers. (*e*) The use of three or four-stage bleeding for raising the temperature of feed water to within 75 deg. or 100 deg. of saturated steam temperature. (*f*) The use of large mills for pulverizing coal.

4. Tendencies which add to the cost of the station without improving either its reliability or appreciably decreasing its coal consumption; for example: (*a*) Insufficient care given to grouping of equipment and waste space in power station building. (*b*) Too many architectural frills.

We realize full well that for a particular set of operating conditions some of the examples we have cited above as falling in one classification may really classify themselves under an entirely new head. An inspection of the curve given in Fig. 2, however, presses home to us the conviction that every tendency that makes for an increase in the cost of our steam-generating stations and correspondingly increases the fixed charges must be viewed with suspicion, and the burden of proof should be on the designing engineer to show why the particular feature should be embodied in the design. The same

line of reasoning indicates that the designing engineer should give intensive study to those tendencies of power station design which hold forth promise of giving lower first costs and lower fixed charges, as well as lower fuel costs.

TREND OF HYDRO DESIGN

Now, turning to the field of hydro-electric plant design and operation, we find somewhat different conditions obtaining and no such revolutionary changes taking place as in connection with steam station design. There is one definite tendency in hydro-electric plant design which is very similar to that which has made itself evident in recent years in steam station design—namely, the trend toward the use of larger waterwheel turbines and larger waterwheel generators. In the main, the objective is not higher efficiency, but lower cost per unit of installed capacity. The tendency seems to be toward using as large waterwheels as the turbine manufacturers can build in single runner vertical turbines for the operating head that is to be developed. An effort is then made to match this waterwheel turbine with a generator that will permit of delivering the full output of the waterwheel turbine to the station busbars. Waterwheel type generators of 65,000 kva. have been built.

It is true, however, that these generators have been built for special plants, and that only in a few cases has a maximum rating of 35,000 kva. been exceeded. However, the size of generators is economically dependent entirely on the individual case and its relation to the size and charging current of the transmission lines, if not limited by the maximum possible output from the waterwheel turbine.

In the future it is going to be even more important than in the past to build water-power plants with a low first cost per unit of capacity. This must be done if the power from water-power plants is to compete with power from the larger and more efficient steam-generating stations. The use of larger generating units is the one means that holds forth most promise for decreased station costs. Further, with the greatly increased total loads in connection with the big power systems, it becomes perfectly feasible to install generating units of large capacity. The tying of a number of plants into the transmission network of a large system makes single unit water-power developments practical, and combined with remote or supervisory control, such developments permit a simple layout, resulting in low operating expense. This is particularly the case with some of the smaller power sites which are relatively close to existing developments. Simplicity of layout is very desirable, as it has a direct effect on reduction of costs, both capital and operating.

Open-Air Substations in Switzerland

OPEN-AIR electric installations are not so frequent in mid-Europe as in America. They are gaining ground, however, in Switzerland particularly. The most important is the substation of Oltens, the principal one of its type in Europe, which furnishes energy to the Swiss Federal Railways. This open-air station has five single-phase transformers rated at 3,000 kva. reducing the high-tension current of 60,000 volts to 15,000 volts for energizing the trolley wire of the neighboring railway line. The frequency is 16.66 cycles.

All circuit breakers are governed by remote control, being operated from a special control room. The main breaker is rated at 250,000 kva., but in case of short-circuiting it will open 600,000 kva. Each circuit breaker has ten points of rupture, the insertion of resistance permitting gradual opening and closing. All the insulators on the 60,000-volt line are tested at 200,000 volts and those on 15,000-volt lines at 65,000 volts.

Electrical Development in Bergen, Norway

THE Bergens Elektrisitetsverk celebrated the twenty-fifth anniversary of its electrical service to the city of Bergen, Norway, on March 10 of this year. During the quarter century the capacity of its plant has grown from the original installation of 480 kw. to a present capacity of 35,200 kw., while existing interconnections and contemplated developments will increase the total power available to 150,000 kw. within a few years. The number of consumers has also grown in this twenty-five-year period from 368 to 35,200 in Bergen and adjacent territory.

The initial installation was a steam plant, but succeeding additions have been hydro-electric, two plants—one at Froland of 21,700 kw. and one at Bjolva of 12,500 kw.—now being under construction and a third, the Dale hydro-electric plant, in contemplation. The table herewith shows the growth of the company and its gradual change from direct to alternating current. The peak load at present is 23,600 kw.

DATA ON GROWTH OF BERGEN ELECTRIC COMPANY

Year	Total Kw.-Hr. Output	Percentage Converted into Direct Current	Kw.-Hr. per Inhabitant	Capacity of Machinery in Kw.	Running Hours
1900	157,000	100	2	375	684
1911	3,500,000	100	41	2,330	2,380
1915	18,600,000	70	200	10,800	2,550
1920	59,200,000	45	545	16,800	4,050
1924	118,800,000	26	1,060	35,200	5,430

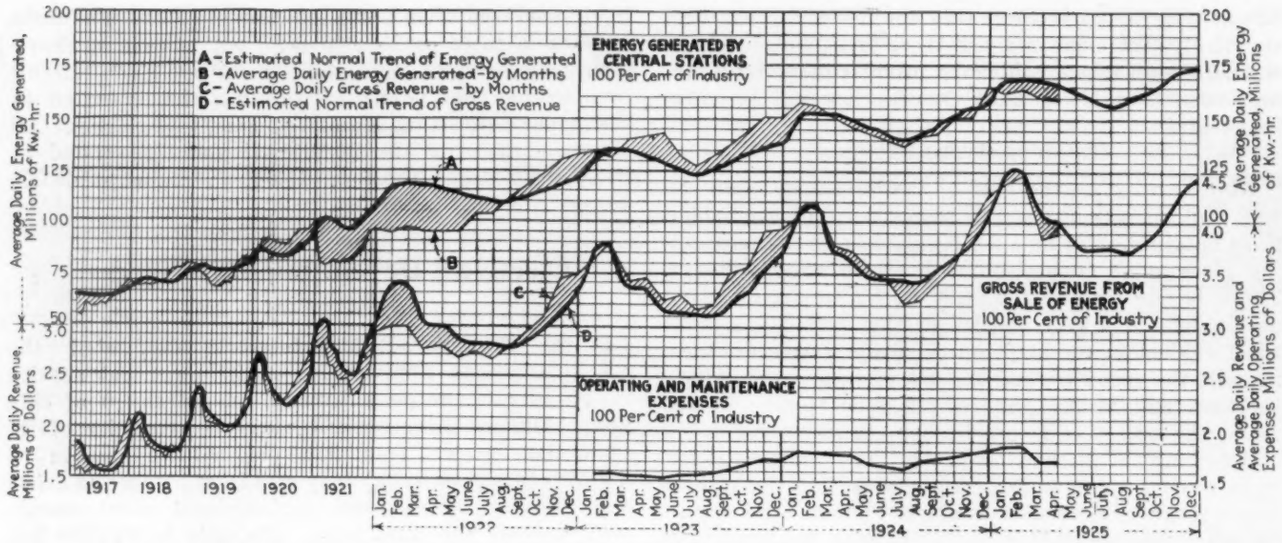
The residence load in Bergen is particularly high, this type of demand representing 63 per cent of the peak load and 70 per cent of the total output of the plant. More than one-half of the kitchens in Bergen are completely electrified, and a majority of the homes use some form of electrical heating.

April Output 10.1 per Cent Over Last Year

A TOTAL of 4,784,986,000 kw.-hr. of energy was generated by the central stations of the country during April, or at an average daily rate of 159,500,000 kw.-hr. These figures indicate an increase of 10.1 per cent over the output of April last year, which is considerably above the increase reported for the first quarter of the year, 5.9 per cent. The April output was 3.4 per cent below the estimated normal for that month, this normal being based on the operations for the past five years.

The gross revenue during April totaled $116,800,000 and the operating expenses totaled $51,750,000. A detailed discussion of the financial operations of the industry will be found in the Financial and Corporate Section of this issue.

A very noticeable increase in the amount of energy consumed for industrial power purposes is indicated


A – Estimated Normal Trend of Energy Generated
B – Average Daily Energy Generated – by Months
C – Average Daily Gross Revenue – by Months
D – Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
Average Daily Energy Generated, Millions of Kw.-hr
Average Daily Revenue, Millions of Dollars
Average Daily Energy Generated, Millions of Kw.-hr
Average Daily Revenue and Average Daily Operating Expenses Millions of Dollars
1917 1918 1919 1920 1921
1922 1923 1924 1925

during March and April. For February the consumption for power purposes was only slightly above that of February last year, but in March consumption by this type of customers had increased to 11.4 per cent above last year, and in April it was 14.2 per cent over April of last year.

The reports indicate that considerably more energy is being generated in hydro-electric plants this year than last. In March the energy generated in hydro-electric plants totaled 2,011,285,000 kw.-hr., an increase of 17.9 per cent over last year, and in April a total of 1,989,364,000 kw.-hr. was generated in this type of plant, an average increase of 9.6 per cent over last year. There has been a very decided drop in the amount of fuel oil used in central-station plants. In March the amount of fuel oil consumed was 47.0 per cent under that in 1924, and in April the consumption of this type of fuel was 43.8 per cent under April of last year. The amount of gas consumed during April, however, was 22.6 per cent over April of last year.

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business Including Line Losses, Kw.-Hr.			
	1925 Thousands	1924 Thousands	Per Cent Inc.	1925 Thousands	1924 Thousands	1925 Thousands	1924 Thousands	1925 Thousands	1924 Thousands	1925 Thousands	1924 Thousands	1925 Thousands	1924 Thousands	1925 Thousands	1924 Thousands
February	4,598,454	4,465,858	3.0	3,710,454	3,604,858	1,044,000	1,000,000	2,181,454	2,114,858	485,000	490,000	888,000	861,000	745,500	663,000
March	4,963,854	4,595,960	8.0	4,006,354	3,708,960	1,123,000	1,075,000	2,347,354	2,109,960	536,000	524,000	957,500	887,000	768,000	704,000
April	4,784,986	4,351,120	10.1	3,859,986	3,511,120	1,067,000	1,022,000	2,283,986	2,006,120	509,000	483,000	925,000	840,000	768,000	682,500

* Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

TABLE II—CENTRAL-STATION FINANCIAL OPERATIONS FOR THREE MONTHS IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Gross Revenue from Sale of Energy†			Operating and Maintenance Expenses‡			Operating Ratio					
							Steam Plants		Hydro Plants		Combined Steam and Hydro Plants	
	1925 Thousands	1924 Thousands	Per Cent Increase	1925 Thousands	1924 Thousands	Per Cent Increase	1925	1924	1925	1924	1925	1924
February	124,800	116,500	7.2	51,800	50,700	2.4	42.9	45.7	30.9	27.1	40.3	44.0
March	119,200	111,500	6.8	52,500	51,500	2.0	43.0	46.0	30.0	28.0	39.0	42.0
April	116,800	108,200	7.8	51,750	48,240	7.2	44.0	49.2	29.0	29.0	40.5	46.8

† Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡ Do not include interest, taxes, depreciation or sinking fund.

TABLE III—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL POWER PLANTS IN THE UNITED STATES||
(100 per Cent of the Industry)

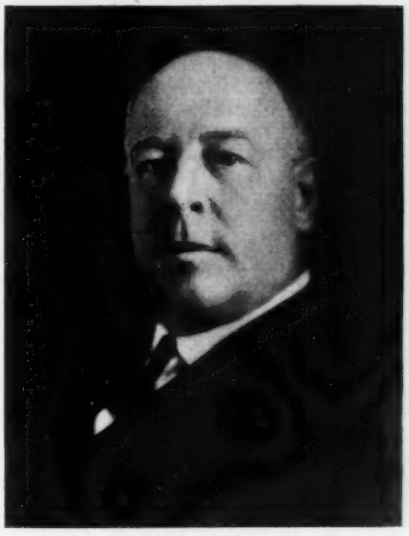
Month	Energy Generated						Fuel Consumption								
	Hydro Plants			Fuel Power Plants			Coal			Oil			Gas		
	1925 Thousands of Kw.-Hr.	1924 Thousands of Kw.-Hr.	Per Cent Inc.	1925 Thousands of Kw.-Hr.	1924 Thousands of Kw.-Hr.	Per Cent Inc.	1925 Short Tons	1924 Short Tons	Per Cent Inc.	1925 Barrels	1924 Barrels	Per Cent Inc.	1925 Thousands of Cu.Ft.	1924 Thousands of Cu.Ft.	Per Cent Inc.
February	1,718,459	.....	....	2,879,995	.....	....	2,719,427	.....	....	954,556	.....	....	2,457,897	.....	....
March	2,011,285	1,705,060	17.9	2,952,260	2,890,000	2.1	2,761,427	2,781,084	—0.9	793,550	1,496,604	—47.0	3,225,295	3,099,404	4.0
April	1,989,364	1,814,599	9.6	2,795,622	2,525,813	10.7	2,589,599	2,479,826	4.4	656,124	1,167,841	—43.8	3,370,936	2,747,341	22.6

|| As collected by United States Geological Survey. The data are for the electric light and power industry only.

Annual Meeting of the A. I. E. E.

M. I. PUPIN
Incoming President

Saratoga Springs Convention Carries Out a Splendid Program—Muscle Shoals and Saguenay River Developments Are Featured in Hydro-Electric Session—Technical Committee's Report on Year's Progress—Good Papers Presented and Discussed



FARLEY OSGOOD
Retiring President

THE annual meeting of the American Institute of Electrical Engineers was held at Saratoga Springs, N. Y., June 23-26, with an attendance of more than 900. A well-diversified program was carried out, and several new and interesting developments were recorded. The meeting was notable for the manner in which the technical committee reports were presented and discussed and for the splendid discussions of the papers presented at the technical sessions. Outstanding topics that were reviewed concerned the best distribution system to use, the status of cables, developments in oil breakers and new features of transformers. New tools described and discussed included the quadrant electrometer or electrostatic wattmeter, an oscillograph for measuring transients and the klydonograph for measuring line disturbances.

Inspection trips filled the afternoons, an especially noteworthy excursion being made to the General Electric Company's works at Schenectady. Excursions by motor and train to Lake George and other scenic points were also well patronized, as noted in the news account printed last week. An unusually large number of ladies attended the meeting.

At a "feature" meeting on Thursday evening Director W. E. Wickenden of the Society for the Promotion of Engineering Education gave an admirable address covering his impressions of European educational methods, and at an evening meeting on Wednesday Samuel S. Wyer presented a paper on Muscle Shoals and W. S. Lee told of the 540,000-hp. developments at Ile Maligne, on the Saguenay River, in Quebec. President Osgood's address was another feature.

Fine Committee Reports

Art Surveyed and Major Problems Outlined—Great Economy Obtained in Power Production—Status of Transmission—Cable Losses Measured

IN OPENING the convention Farley Osgood chose as the subject of his presidential address "The Engineer and Civilization." Mr. Osgood said that the obligation of engineers to render a broader service was clear and urged more participation on their part in public affairs. He complimented the standards committee and the meetings and papers committee on their work and referred to the increased activity of many technical committees. Mr. Osgood said in part:

"A new state of mind in the engineer must be born. Those most advanced in our art must appreciate their debt of service to the needs of the people not having our training in the determination of facts. Our educators must be brought to appreciate that the training of young men in the technique of their work is but a part of the training for a suitable graduating degree. Our college students must be made to realize that their particular training incurs an obligation to use it for the benefit of all the people wherever it is possible to bring it to bear.

"In many of our commissions and political bodies whose work deals primarily with projects based on engineering we find the make-up largely lawyers, with a few other non-technical men, and as a consequence many engineering experts are called to bring in the scientific and technical facts that proper decisions may be reached. Why, now that the legal and financial bases of most of the investigations by our public bodies have been so well established, should not the personnel consist largely of qualified engineers, and when legal or financial advice is needed, call in the experts from those fields? Would not this seem more logical? Has the training of our scientists and engineers been such as to make them unfit for this duty? If so, it is high time that intensive study should be undertaken to correct such a condition.

"It would seem reasonable for a well-balanced committee of the four founder engineering societies to be formed, selected from many branches of industry and the world work, to co-operate with the Society for the Promotion of Engineering Education, in order to determine most broadly on a proper curriculum for our students, to bring to them a correct blending of technical work and training in human engineering, that our profession may perform its fair share of carrying on the welfare of our people.

"Of course, every engineer in the country cannot be placed in public office, either municipal or state or federal, but all engineers can lend aid in supporting those chosen for the more conspicuous places. Each has his own field of usefulness, by training or by choice, and his feeling of reward should be the satisfaction of service rendered.

"The Master Mind of all creation holds the key of all knowledge. To the scientists is intrusted the unfolding of the fundamental laws of nature, to the engineers their practical application for the benefit of the human race in every possible way. The road is open, our duty is clearly defined, and that our obligations will be fulfilled there is no doubt."

TRANSMISSION AND DISTRIBUTION DEVELOPMENTS

In the annual report of the committee on power transmission and distribution (Percy H. Thomas chairman) six subjects suitable for further discussion were brought out. Among these subjects were the present-day capacity of lead-covered cables, the amount of power that can be handled over a 100-kv. tie line carrying power in both directions, transmission-line vibration and means of reducing installation costs.

With the increased study of important tie lines which may carry power in either direction and with the proposals for the transmission with the aid of synchronous condensers of amounts of power on high-voltage lines near their maximum capacity, the importance and the complexity of the designers' task are just now being realized and the effect of power factor is being recognized.

In connection with the handling of power over tie lines the question was brought up whether tap-changing devices can be relied upon where the interchange between the systems is to be automatic in accordance with the variations of load and with the conditions of most economic operation in the two systems.

F. W. Peek, Jr., Pittsfield, Mass., summarized the causes of insulator flashover on transmission lines as (1) excessive transient voltages and (2) mechanical reasons, including dirt and moisture. Excessive over-voltages are due to lightning or to internal surges, the latter being generally caused by switching or arcs and are relatively infrequent on grounded neutral systems. Cloud lightning is the major cause of excessive voltage transients and with this type of voltage a much greater potential is required for flashover than with 60-cycle voltage. A convenient equation for expressing the flashover voltage on any line is $V = H \times 100{,}000$ where V is the flashover voltage and H the height of the line above the ground in feet. An overhead ground wire cuts down the "lightning voltage" hazard of the line 50 per cent. It may not be good economy in some cases to spend large sums for line protection, but it may be advisable to permit a certain number of disturbances on a line which may not arc over oftener than once in one to five years. The better plan may be to make the trouble as mild as possible by providing the insulator string with the arcing horn or the arcing ring. Sufficient spacing must be allowed to permit arc-over through the air without causing trouble.

Speaking of corona, Mr. Peek stated that it is desirable to design 220-kv. lines for zero corona loss and that no necessity exists for corona loss on such lines because it is easy to make the conductors large enough to prevent it. The size and condition of the surface are the principal factors in the corona of conductors. Discrepancies often occurring between calculated and measured corona losses are usually due to difficulties in considering the various factors which make the conductor surface irregular. The conductor surface is often roughened in installing circuits, as in mountainous regions. After a few years' operation the abrasions are to a certain extent corroded away. Great care should be exercised not to mutilate conductors. The corona equation for critical voltage is very accurate when the surfaces are not mutilated. Corona dissipates lightning, but it must be the corona caused by lightning and not by the 60-cycle line voltage.

PROTECTION PROBLEMS IN ELECTRICAL SYSTEMS

Several interesting trends in connection with the protection of electrical systems were brought out in the report of the committee on protective devices (H. R. Woodrow chairman). It has been the practice in some heavy manual systems to tie the converters or motor-generators solidly to the bus without protection on the direct-current end. Within reasonable limits it is felt that this could be approached in the design of automatic substations for the same class of service. The minimum protection for 600-volt converters and 250-volt motor-generator sets and converters was prescribed.

As regards automatic alternating-current distribution and transformer stations, the protection to service should consist of reclosing features applied to the outgoing circuits. The tendency is to assure power supply at the station by proper overload, balanced or reverse-current protection of the parallel transmission lines supplying the station, or by automatic transfer devices if it is not desirable to have transmission circuits paralleled.

Referring to distribution circuits in the 2,200-volt to 6,600-volt class, it seems to be general practice to reclose these circuits three times before final lock-out. There is a difference of opinion as to just how much time should elapse between reclosures, but on a general average the first reclosure is made in from two to five seconds after tripping, the second about thirty seconds from zero and the third anywhere from sixty to one hundred and eighty seconds from zero.

Considering remote supervision, the committee held a supervisory system to be a very desirable asset to a network, but it should never be forgotten that the reliability of the whole system can be made no better than the wires used in the circuit. The use of reactors is extending to substations on lines operating at generator voltages and also on 2,300-volt and 4,000-volt distribution circuits. This latter application not only reduces the duty on the oil circuit breakers but also on the induction regulators, which on many systems would otherwise be subject to short circuits greater than those they are able to withstand.

The greatly increased size of alternating-current substations has forced attention to proper methods of grounding. In general it may be stated that the problem of grounding is not so much that of obtaining individual grounds of low impedance, but rather one of obtaining a well-distributed ground so as to approach an ideal equipotential area and thereby avoid dangerous potential gradients near ground electrodes when ground-fault currents flow. Water-piping systems afford the best grounding systems obtainable. Where artificial grounds are necessary, the general tendency seems to be away from the use of ground plates and toward the greater use of pipe grounds.

Additional experience with the Petersen earth coil indicates that the high-voltage disturbances which were experienced when the coil was first placed in service have been entirely eliminated by making provisions to do all line switching, both hand and automatic, with the coil out of service—that is, with the system neutral solidly grounded.

P. H. Chase, Philadelphia, pointed out that the simplicity of operation and reliability of the balanced pilot wire method of protection makes it preferable to using the reversed power method on loop feeders. A single-phase calculation table is now being made for studying the local distribution and substation system. Further investigation of the action of arcs, of short circuits on mains and networks with different types of cable, and also the characteristics of fuses is desirable.

R. E. Argersinger, Stone & Webster, Inc., Boston, urged paying more attention to the quality of grounding systems in generating plants, especially where the generator neutral is connected to the neutral of transformers on the high side of the latter. One great advantage of the overhead ground wire on transmission lines is that the system can more easily be tied to ground in case of trouble, averaging up the resistance of the tower paths to ground. Regarding excitation methods, the speaker said that he had recently analyzed the excitation problem for a 40,000-kw. water-wheel installation, with the conclusion that a substantial saving could be made by the use of direct-connected exciters on the main generator shaft. The only difficulty seems to be securing proper voltage regulation at low speed, and the manufacturers claim that they can overcome this.

In discussing the report of the committee on power generation, abstracted elsewhere in this issue, G. L. Alden, described an 80,000-kw. steam turbo-generator recently purchased from the Westinghouse company. This can be made a base load machine now and a peak load machine two or three years later if service requires. A. L. Mudge, Ottawa, Ont., favored the use of direct-

connected exciters mounted on the generator shaft. J. L. Burnham, Schenectady, N. Y., discussed the advantages of the Scherbius type of frequency changer at system interconnection points. Load control can be had without changing governor adjustments on the prime movers of either system. Notable installations are in the Rochester-Niagara district.

DEVELOPMENTS IN ELECTRICAL MACHINE DESIGN

The past year has shown a marked advancement in the art of electrical machinery, not only in the successful starting and operation of machines larger than any ever built up to this time, but also in the purchase and partial completion of machines still greater in size, according to the report of the committee on electrical machinery, of which H. M. Hobart was chairman. Accompanying the trend toward larger sizes of units there has been much investigation along the lines of ventilation, insulation, mechanical strength of materials, losses in iron and copper, the effect of expansion and contraction on the insulation of long armature coils, balance of the moving parts and the disipation of heat from flat surfaces.

Tests made recently show that the temperature of the bare copper in commercial machines insulated for 12,000 volts to 14,000 volts is approximately 15 deg. greater than the temperature determined by a detector placed between the top and bottom coils when the latter is from 55 deg. to 60 deg. above the temperature of the ingoing air. Ventilation is usually obtained by a multiple radial system in which the air passes radially in and out through the stator core. The past year has not only seen the largest synchronous frequency changer yet built put in operation, but has also seen an induction-type frequency changer of the same capacity installed and successfully operated. The rating of these machines varies from 35,000 kw. to 40,000 kw. A new type of frequency converter has been developed for tying together two systems, the frequency of each being susceptible to changes. This type is known as the Scherbius-controlled, load-regulating type of set.

Improvements made in transformer design include a new type of ratio adjuster switch by which the ratio can be altered while the transformer is carrying load. Some 22,000-kva., single-phase, oil-immersed, water-cooled transformers, having 12,000-volt delta-connected primaries and 39,500-volt secondaries Y-connected to give 68,500 volts, were put into operation. These transformers were for 25 cycles.

Experiments on the gaseous ionization in built-up insulation were conducted and showed that the losses due to internal ionization caused a progressive deterioration of insulation, even though the absolute values of these losses in well-constructed armature bars are small compared with dielectric losses of other types.

During the past year work was done on the development of a special type of alternating-current generator having the proper low voltage wave form for giving a more nearly smooth rectified direct potential and provisions were made for manually or automatically varying the wave form to maintain a steady potential for varying load demands.

The use of direct-current saturation in the iron cores of static alternating-current apparatus in radio work has been in vogue for some time, and of late is being used commercially in voltage regulators and current-limiting reactors. However, due to cost and inefficiency, the saturated-core voltage regulator and current-limiting reactor are at present confined to specific uses in which speed of operation is desired in the case of the voltage regulator and increasing reactance with alternating current is desired in the case of the current-limiting reactor.

Saturated iron-core current-limiting reactors have been installed in a large central station between the essential auxiliary bus fed by a house generator and a miscellaneous auxiliary bus fed by a house transformer. These reactors are designed to carry 660 kva. under normal operating conditions, at a reactance drop of 15 per cent. The short-circuit reactance is approximately 38.5 per cent, which will not allow more than 1,710 kva. to pass through the reactors at normal voltage.

PRECISION WATT-HOUR METERS

The committee on instruments and measurements (A. E. Knowlton chairman) has two surveys under way. The first concerns the development of a device or devices for the measurement of energy directly in terms of watt-hours under the condition of excessively fluctuating power, for averaging this variable power with laboratory precision and for producing results equivalent in accuracy to those obtained with laboratory equipment now used for the measurement of volts, amperes and watts. The second is an investigation of the available instruments for use with frequencies in the audio and radio ranges. Their fields, operating principles, limitations and scope of applicability will be covered.

D. W. Roper, Chicago, commended to the committee's attention the problem of measuring dielectric losses and power factors on high-tension cables. At present, he said, each manufacturer has his own method. Recently the speaker sent two pieces of the same cable off the same reel to two different manufacturers and their measurements of dielectric loss varied more than 100 per cent. The speaker urged the importance of more fundamental research on high-voltage cables. During the past five or six years American manufacturers have increased the dielectric strength of cable 50 per cent, cutting down dielectric losses to the point where failure from this cause cannot occur, but this has been done at the cost of cable life. On the Chicago system cables of the rosin and oil type have operated fifteen years with no sign of ionization, but when modern compounds are used the life of cable insulation has been cut down sometimes to only fifteen months. One manufacturer admits using eight different impregnating compounds in the past five or six years. "Present research is not of the fundamental variety," said Mr. Roper; "cable made with the various impregnating compounds is given the ordinary but apparently not the right test to determine the life of the insulation. Manufacturers have reduced their guarantees from five years to one or two years, shipping cable with a modicum of faith, an abundance of hope, but without charity." G. B. McCabe, Detroit, corroborated Mr. Roper's general position.

W. A. Del Mar, Habirshaw Cable Company, Yonkers, N. Y., said that the demand for low dielectric losses has led cable manufacturers to adopt compounds which are unstable under stress. The cause of this instability is being sought. Research has already shown that material formed in high-tension cable under prolonged stress is an oxidation product. The oil solidifies in the presence of oxygen. If the cable is thoroughly saturated with air-free oil this cannot occur. This hard material is a product of certain elements in the oil. Oils can be compounded to yield a small proportion of these elements. Accelerated aging tests at three times the working voltage for one to two weeks indicate that the latter oil is stable because in all the older oils deterioration occurred. No name has as yet been found for this material. It has proved insoluble in over 150 solvents with the possible exception of hot hydrochloric acid. It burns before it vaporizes, but does contain a small amount of oxygen. Mr. Del Mar said that his company uses three systems of measuring power factor, and if these three agree, the result is considered reasonably satisfactory. The speaker urged instrument men to consider means of measuring power factors in cable work, the problem being one to tax ingenuity.

ACTIVITIES IN RESEARCH

Activity in the field of electrical research has continued unabated during the past year, according to the annual report of the committee on research (John B. Whitehead chairman). In the field of high-voltage transmission and power distribution there is an increasing tendency to investigate the performance of such systems through experimentation with models, miniature systems and equivalent networks. Important new data have been made available as to lightning disturbances and methods of protection.

A general review of the work in electrical engineering research during the past year reveals two striking facts—first, the great amount of experimental research under way and the wide range of the problem; second, the lack of co-ordination among various workers in the same or allied fields. Obviously, a function of the committee on research should be the bringing about of such co-ordination if in any way possible.

The concrete suggestion of the committee is that large organizations the chief function of which is to promote experimental research could with profit maintain as a part of their organization a few competent men trained in science, engineering and in methods of research, their principal duty to be the presentation of the work of the past, problems of the present and plans for

concerted experimental attack for the future. The volunteer research workers would do the rest.

In closing the discussion on the above committee reports, Prof. J. B. Whitehead said that a moderate corona loss may be permitted on a short section of a line (a mile or two *in toto*), as a protective measure. Mr. Thomas touched upon the importance of not making insulator strings too high in insulation strength lest lightning discharges enter stations. He favored the use of synchronous condensers as the cheapest and easiest means of securing good line voltage regulation and said that the insertion of a series static condenser in the line recommended by T. A. Belt for some cases opened the door to over-voltages.

Industrial Fields Developing

Committee Chairmen Record Progress in Electrical Applications—Lighting and Communication Make Notable Advances —Standards Developing Rapidly

THIS year's report of the committee on general power application (A. E. Waller chairman) consisted of a summary of general progress in applying electricity to industrial uses as recorded in engineering publications during the year and a very detailed bibliography on motor and control application, mechanical end of motor drive, industrial substations and electric power distribution systems in industrial plants. Two subjects suggested as well worthy of study are group control of motors, sectionalized drive and power factor and load factor —their control in industrial applications.

Advances in Use of Electricity in Mines

The electrification of coal-loading machinery is receiving a great deal of attention from the manufacturing engineers as well as from the coal-mine operators, according to the report of the committee on applications to mining work (F. L. Stone chairman). There seems to be no other practical method of drive for these machines, and, as in the majority of mine applications, improper motors have been applied on early machines, with the usual result.

There is still a great deal of work of an educational nature to be done so far as the mine operator is concerned. The motors required for his work should be almost invariably of a special design laid out to meet mining conditions. Standard industrial motors are very rarely applicable to this class of work, and their application usually ends in delays and dissatisfaction.

Progress in the Iron and Steel Industry

Every year shows a steady and remarkable increase in the application of electricity in the manufacture of steel, according to the committee on applications to iron and steel production, of which F. B. Crosby was chairman. No marked improvements in distribution have been reported, but the use of purchased power has rapidly increased as the size and reliability of commercial power systems has increased. To an even greater extent than usual this past year has been marked by a replacement of existing engine drives by modern electrical equipment. As an example of this there was in existence on June 1, 1925, 1,512,500 hp. in main-roll motors in units above 300 hp., as reported by three of the principal electrical manufacturers. This is an increase of 220,000 hp. over 1924.

An interesting tendency in auxiliary mill-motor control is toward the use of time-limit acceleration instead of current-limit, which has long been the accepted standard.

With the expiration of patents covering certain alloys for use in resistor units, development of annealing and heat-treating furnaces has received marked impetus. Furnaces of large capacity with temperatures of from 1,800 deg. F. to 2,000 deg. F. are being installed in considerable numbers.

The use of arc welding as a means of repair of worn and broken parts in steel mills has shown a great increase. Conditions in the development of "arc furnaces" for melting steel and iron have become fairly well standardized. Continued investigation of the two-voltage system of operation—a high voltage for melting followed by a low voltage for refining—indicates that there is no deleterious effect on the product while there is a decided saving in the power and electrode consumption.

Rules and Personnel of the Marine Field

Virtually all of the work of the committee on applications to marine work (L. C. Brooks chairman) during the past year has been on the revision of the existing marine rules that were issued about five years ago. It was suggested that during the next year an inspection to include electrical devices for marine use be developed and that the scope of the committee be extended to include certain branches of manufacturing not already included within the scope of the marine rules.

Electrochemistry and Electrometallurgy

The revision and extension of the section on storage batteries in the "Standards" of the Institute was recommended in the report of the committee on electrochemistry and electrometallurgy. The section on the method of rating storage batteries is not entirely clear, and serious difficulties have recently arisen in the matter of rating the various sizes and kinds of storage batteries for use on automobiles and for radio purposes. The rapid growth of the automobile industry and the still more recent development in growth of radio have resulted in a very great expansion of the storage-battery industry.

According to the committee, high-frequency induction furnaces are finding increased use for laboratory and experimental purposes and also for small-scale production. The larger sizes are now operated on high-frequency generators, while the smaller units may be operated by electron tubes. Electrolytic rectifiers have become a subject of renewed interest as a result of the phenomenal growth of the radio industry. Improved forms of both the aluminum and tantalum rectifiers have recently appeared. Scientific methods are now being extended in the field of electroplating, the structure of electrodeposited metals has been studied and new methods for the regulation of plating baths and hydrogen-ion control have been introduced. A bibliography is included in the report.

Communication Art Advances

The report of the committee on communication (O. B. Blackwell chairman) summarized briefly the advances which have been made in communication. The development of long telephone cables of nineteen-gage and sixteen-gage, capable of operating for distances of 1,000 miles and more, has led to the development of telegraph systems suitable for operating through these cables. The most radical change in the submarine cable art is the new permalloy-loaded submarine telegraph cable between New York and the Azores Islands, put into service by the Western Union Telegraph Company.

A brief statement was given in last year's report of the development in the use of short waves of 100 meters and less, and surprising results had been obtained under certain conditions. While much more remains to be done before it will be possible to predict definitely the action of such waves, they are already being put into important practical use for telegraph purposes. Four of the long transatlantic circuits are now being supplemented by short-wave systems.

There has been during the past year a large amount of activity in the electrical transmission of pictures. Development has so perfected this system that the transmitted pictures present an appearance differing very little from that of the original photograph.

Revised Standards

During the past three years the attention of the standards committee has been focused primarily on a general revision of the Institute "Standards," both as to form and content, according to this year's report of the committee, of which H. S. Osborne is chairman. There are about forty different sections to the present "Standards," of which twenty-two have been revised and are now available. The present organization of the committee, in view of the increasing complexity of the standardization work in which the A. I. E. E. is directly concerned, is believed to be admirably suited to this purpose.

Progress in Lighting

The chief developments in illumination during the past year, according to the committee on production and application of light (G. H. Stickney chair-

man) are the better and more intensified applications of light. Although marked improvements have been made in lamp manufacture, attended by several reductions in prices, present-day illuminants are still far from the scientific ideals of efficiency. New applications of incandescent lamps have increased the number of special types, and in consequence engineers are now studying means of standardizing a few types. Increased activity has been shown in store-window lighting, colored light and spotlights making merchandise more attractive. About 15 per cent more equipment was used for new street-lighting installations and replacements during the past year. The trend seems to be still toward ornamental units. Flashing traffic beacons and traffic-control signals are being installed in increasing number, the latter being synchronized and extended outside congested centers.

Muscle Shoals and Ile Maligne

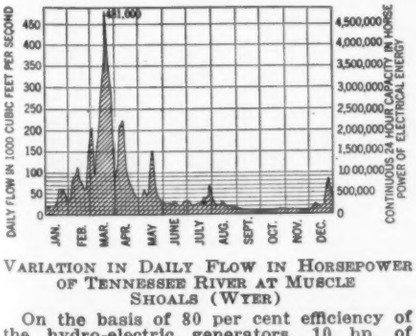
Noted Engineers Survey Possibilities of Two Major Hydro-Electric Developments—General Disposal of Power Advocated —Statistics of Projects Recorded

THE largest single installation in water-power development ever undertaken is at Ile Maligne on the Saguenay River in the Province of Quebec, Canada, where a total power-house installation of 540,000 hp. is being made, of which 360,000 hp. is completely and 180,000 hp. partly installed. This development was described in a paper by W. S. Lee.

The building of this station in a remote section, where extreme difficulties are caused by bad weather and floods, called for very careful planning and co-ordination of the various parts of the work. The steps in the construction of this plant were shown by Mr. Lee at much length, but this was done largely to bring out the value and importance of designing with the idea of co-operation with the contractor or the construction forces.

Power Possibilities at Muscle Shoals

In a paper presented by Samuel S. Wyer and based on the public records of the War Department the fundamental features of Muscle Shoals were described, including the work that has been done to date and the work that can be done in the future. In general, the primary power that may be depended upon at the Wilson Dam at Muscle Shoals is 100,000 hp. continuous



Variation in Daily Flow in Horsepower of Tennessee River at Muscle Shoals (Wyer)

On the basis of 80 per cent efficiency of the hydro-electric generators, 10 hp. of electrical energy will be generated for each cubic-foot-per-second flow at the Wilson Dam at Muscle Shoals.

output. However, there will be occasional days when the primary power will drop to about 87,000 hp.

In addition to the 100,000 hp. of primary power that can be developed at the Wilson Dam, the quantities of additional secondary power shown in the accompanying table can be developed for the respective per cents of total time shown for two conditions of river flow. The total area of the drainage basin is 30,800 square miles, there is no storage, the head that can be developed is 95 ft. The variation in daily flow in horsepower of the Tennessee River at Muscle Shoals is shown in the accompanying illustration.

The present hydro-electric power plant is at the southern end of the dam and is an integral part of the main dam construction. The building is 1,250 ft. long, 160 ft. wide and 134 ft. high, built of monolithic and reinforced concrete. Four complete generators, each rated at 30,000 hp., are now being installed, also four rated at 35,000 hp. The building is large enough to permit the later installation of ten additional units, each of 35,000 hp. Thus the proposed future capacity of the plant is 610,000 hp.

SECONDARY WATER POWER AT MUSCLE SHOALS

Additional Secondary Hp.	Approximate Percentage of Total Time Available: Low-Year Daily Discharge Basis	Mean Monthly Discharge Basis
50,000	56	85
100,000	44	72
150,000	32	63
200,000	24	55
300,000	15	42

Concerning possible future developments, there are twelve dams that may be built in the Tennessee River drainage basin. The 100,000 primary hp. capacity at the present Wilson Dam, plus the 751,000 primary hp. at the proposed twelve dams, plus the increase in primary hp. capacity that regulated stream flow will produce in the present Wilson and Hale's Bar Dams, will give a primary horsepower capacity for the Tennessee River of approximately 1,000,000. Thus it is obvious that Muscle Shoals is a mere incident in the Tennessee River development program, and it must be evaluated from this viewpoint.

Electric power has completely revolutionized industrial living and social conditions in parts of the South. In Alabama, east Tennessee, Georgia and the Carolinas hydro-electric power is largely employed in various industrial and textile activities. Western Tennessee and practically all of Mississippi have been touched by power systems and are now waiting for the development program of the Tennessee River.

Distribution Systems Debated

Utility Engineers Disagree—Oil-Breaker Performance Questioned—Cables Making Progress—New Measurements Recorded —Applications of Quadrant Electrometer

A VERY active discussion followed the presentation of the papers on Thursday morning. The question of the best secondary distribution system found many system engineers with different opinions which could be accounted for largely on the basis of their starting assumptions and the influence of local conditions on the different properties.

The papers on two-phase, five-wire distribution by P. H. Chase and on the oil-circuit breaker situation by E. C. Stone will be abstracted at length in the next issue. A. H. Kehoe opened the discussion on P. H. Chase's paper.

"If one first reads the conclusions of the Chase paper, which are carefully drawn, he is apt to take a more generous view of the partisan statements which appear earlier in the text. For instance, the emphasis on cost of making system changes is well placed. Concerning the subject of a combined light and power system, we believe it can be demonstrated that, starting *de novo*, the advantages and disadvantages of two-phase or three-phase will be so nearly balanced that any difference in cost will come well within the accuracy of the original assumptions. In practical applications, however, there are three factors which should always receive consideration:

"First, the sources of power and transmission, if these exist, are three-phase, and the country in general is, and will doubtlessly remain, on a three-phase basis for general polyphase utilization. This necessitates the use of special polyphase devices where two-phase, five-wire, is adopted.

"Second, the three-phase, four-wire system requires an odd voltage, according to present standards, for either one or both of the single or polyphase loads.

"In addition to the above, the adaptation of existing equipment for combined light and power should be accomplished with minimum cost.

"In the two locations where two-phase, five-wire light and power distribution systems are contemplated at the present time there is little doubt that, owing to the existence of a two-phase system, it is much cheaper to retain the two-phase than it is to change over to a three-phase, four-wire supply. These two locations are the exceptions, however, and the same elements of cost have the opposite effect on the typical systems of the country, which, of course, are three-phase. The systems adopting two-phase, five-wire, will perpetuate non-standard polyphase equipment, while the three-phase, four-wire systems will force certain rating compromises but should be able to utilize standard equipment, both exist-

ing and new. Just what this later effect will be depends upon what voltages are selected. The author has everywhere in his paper ignored 120/208-volt, three-phase, four-wire, which seems to me seriously to affect some of his deductions. This voltage appears to be the only compromise which can be adopted that will allow all existing standard equipment to be utilized successfully.

"The speaker has noted such a large number of exceptions in the detailed text of the paper that it would be impossible to comment upon all of them. I will, therefore, deal with but four or five matters which seem to be of such importance as to justify the time taken in making the presentation.

"On page 2 the section headed 'Power per Wire' hardly justifies serious comment, for, carrying the matter to its absurd conclusion, the system proposed by the author is but 80 per cent efficient. Seriously, however, we all must appreciate the tremendous advantage of the simple three-wire direct-current system. It is the obvious necessity of generating and transmitting polyphase as well as having some polyphase utilization that makes it necessary even to consider the complications of going to four-wire or five-wire systems to obtain balanced loading on a single system. This whole paragraph, in the opinion of the writer, is not the proper type for our technical literature. It may be well, however, to bring out the fact that neutral wires have to be sufficient to carry the unbalance, which depends upon the utilization equipment and not the type of system.

"Under 'Inherent Advantages' (page 3) the question of accommodating phases in separate ducts introduces the element of polyphase motors acting as phase converters while running single-phase. This condition at times of secondary short circuits is one of the problems for which there has not been sufficient operating experience to obtain a positive solution. It seems certain, however, that separate polyphase secondary cables in separate ducts will not improve the hazard which already exists in the matter.

"On page 4 mention is made of polyphase transformer units. I wish to emphasize this, as in the writer's opinion we have scarcely begun the economic use of polyphase units that will come automatically as soon as the light and power systems are established in a reasonable number of places.

"With reference to Scott connection as a hybrid scheme, some of us who have not reserved our judgment on this matter to the extent of agreeing with the author believe we are basing our conclusion upon common-sense engineering. Regarding the unbalance due to Scott transformation, it should be realized that this occurs at the source of the supply, while the voltage unbalance set-up in the case of secondaries occurs at the end points of the line. It is doubtful whether any quantity of secondary light and power mains would be installed in the country with spacing as indicated on page 4. Our telephone friends might be interested.

"On page 6, in discussing primary voltages higher than 4,000 volts, the author speaks of the older natural distrust as if the distribution conditions of the last ten years were not justified. We believe that it has just been demonstrated by a different design of system that it is possible to distribute at the generator voltage, and any distrust which has existed in the past was a very proper one for the systems then in use."

H. R. Woodrow said that systems were growing so rapidly that distribution should be studied on the basis of starting new and that present installations should have little influence. He disagreed with Mr. Chase on many points and pointed out that the increased number of wires, the increased cost and the lack of standardization connected with two-phase, five-wire as compared with three-phase, four-wire construction made the former a second choice for secondary distribution. P. H. Adams also disagreed with the conclusions of Mr. Chase and cited the experience of the Public Service Company of New Jersey in remodeling its system to insure better economy and greater reliability. L. T. Robinson stated that it was essential to decide upon a standard distribution system at an early date as the cost and complexities connected with the use of non-standard apparatus was responsible for waste in the industry. Other discussion occurred, disagreement with the conclusions of Mr. Chase being quite general.

An active discussion on oil breakers was participated in by European as well as American engineers. A. H. Kehoe asserted that most breakers are bought on the basis of extrapolated data, particularly with respect to the value of recovery voltage. As systems grow larger the recovery voltage will grow larger, and this has an important bearing on breaker performance. Tests should be made using the maximum possible system voltage as the breakers may have to withstand double normal voltage. The contact resistance at the short circuit should be studied. Data on cable arcs show about 200 volts as contact resistance effect across the arc. This is of little importance on 13,000-volt circuits, but indicates that the higher the voltage the less destructive this effect will become.

O. T. Marti observed that in Europe the use of resistance breakers with a value of resistance about ten times the short-circuit impedance had lowered the duration of the arc a quarter, the breaker duty one-tenth and the volume of gas and pressure of the oil one-fifth. He also gave a table of breaker ratings now used in Europe and described a new contact device using two series coils. This contact device closes the breaker against the electrodynamic forces resulting from an arc and arc gases.

W. S. Edsall said that European breaker rules have been developed recently, as shown by Mr. Marti, and pointed out that non-standard mounting specifications in this country added greatly to breaker costs.

Dr. Arnold Roth, a visiting French engineer, asserted that the voltage followed the change in current from initial to sustained short-circuit values and this gave a good indication of kilowatt-ampere changes and the value of recovery voltage. He stated that in Europe the inadequacy of breaker ratings as systems grew was met by changing relay time settings, often allowing four or five seconds. In a visit to American properties he had obtained conflicting reports on breaker performance. Secondary explosions seemed almost impossible from the data European engineers had available, but in America these are said to occur frequently.

J. B. MacNeil maintained that the many different application requirements for breakers made it difficult to utilize all possible design principles in any one breaker. The magnetic blowout, for example, he said, is not important or necessary for high-voltage, low-current applications, yet has been used in this country for low-voltage, heavy-current applications. Moreover, the blowout may lengthen the arc many

DUTY IMPOSED ON ONE BREAKER POLE ON TWO-PHASE AND SINGLE-PHASE SHORT CIRCUITS COMPARED WITH DUTY ON THREE-PHASE SHORT CIRCUIT*

Quantity	Nature of Short Circuit	Short Circuit via Transmission Lines and Transformers	Short Circuit at Generator Terminals (without appreciable line impedance)	
		Initial Short Equals Sustained Short	Initial Short	Sustained Short†
Current interrupted, per cent	Three-phase	100	100	100
	Two-phase	$\frac{\sqrt{3}}{2}\times 100 = 87$	About 100	About 115–150
	Single-phase	100	About 115	About 150–200
Voltage, per cent	Three-phase	100	100	100
	Two-phase	$\frac{1}{\sqrt{3}}\times 100 = 58$	$\frac{1}{\sqrt{3}}\times 100 = 58$	About 65–85
	Single-phase	$\frac{100}{1.5} = 67$	$\frac{100}{1.5} = 67$	About 85–115
Interrupting capacity, per cent	Three-phase	100	100	100
	Two-phase	50	$\frac{1}{\sqrt{3}}\times 100 = 58$	About 75–125
	Single-phase	$\frac{100}{1.5} = 67$	$\frac{115}{1.5} = 77$	About 125–230

*The table is based on the assumption that the impedance of the generators in each phase is smaller by about 15 per cent on two-phase and single-phase short circuits when compared with three-phase short circuits, owing to the magnetic interlinkage of the phases.

†In the last column the first figure refers to low-speed generators, the second figure to turbo-generators

BREAKER RATINGS USED IN EUROPE

times. An American breaker utilizing this principle has, however, been used to extinguish the arc in one-half cycle on an 18,000-amp., 11,000-volt-to-ground single-phase circuit. Mr. MacNeil also said that the voltage does not follow the current changes under short-circuit conditions, as in the first half cycle the voltage is higher than normal and may even reach double normal value. Resistance breakers have also been developed and used in this country but have a limited application.

High-speed breaker contacts offer great possibilities in breaker design, Mr. MacNeil continued, as the high speed limits the time of arcing and the burning of contacts besides improving system service. He showed old and new oscillograms of breaker performance, indicating that the new breakers extinguish arcs in about half a cycle as compared with three or four cycles in older types. He stated that multiple-break units had been developed and used in this country, but that American experience was that better results and better economy result from building single-break units. If an arc can be extinguished in one-half cycle as at present, no advantages can be seen in the use of resistance or multiple breaks.

Dr. M. I. Pupin thought that both the principle of conservation of energy and the principle of conservation of momentum should be used in breaker design.

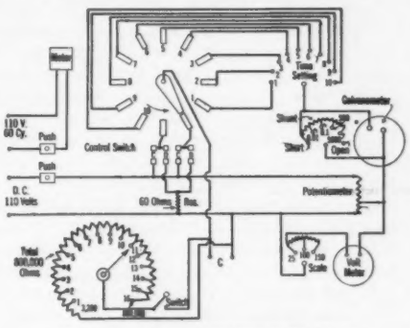
The Quadrant Electrometer

The theory of the quadrant electrometer was discussed by W. B. Kouwenhoven from the standpoint of power measurement. He has produced an accurate general equation and reduced it to a simple form. He showed that the constants of the quadrant electrometer may be determined with continuous current and that these constants also apply in alternating-current power measurement. Data of the determination of the constants of a given instrument with continuous current were given, as well as examples of the use of the instrument in the measurement of power in a number of alternating circuits having different characteristics.

New Method for Measuring Dielectric Absorption

An instrument called a dielectric lag meter for measuring dielectric absorption has been developed and was described in a paper by R. E. Marbury. This meter measures the instantaneous values of voltage across the condenser by direct comparison with known voltages. The apparatus consists of an arm switch rotating at a constant and known speed, a potentiometer for varying the value of the known voltage, a galvanometer circuit and a means for selecting the instant of time at which the measurement is to be made. The accompanying illustration shows the rotating arm switch with twelve stationary contacts, the galvanometer and potentiometer circuits, and in addition a variable resistance in parallel to the condensers. The variable resistance is not used in making residual voltage curves, but is provided for making discharge curves. Three different types of test which may be made by means of this instrument are residual voltage against time, residual voltage against applied voltage and discharge curves with condenser and resistance.

A discussion of the quadrant electrometer brought congratulations to Dr. Kouwenhoven for the complete so-



Connection of Dielectric Lag Meter (Marbury)

lution of the equations of this instrument and accented its usefulness as a very accurate measuring device for dielectric and magnetic losses uninfluenced by wave shape or frequency. It was suggested that the instrument should be called an electrostatic wattmeter.

In discussing the paper of R. E. Marbury, W. F. Davidson said that insufficient data were given as to test methods and assumptions to determine the scientific accuracy of the results. There is nothing uniform in cable oil impregnation nor in cable dielectrics, he said, and uniformity cannot be assumed. Moreover, a long time must elapse between tests on absorption if real values are desired.

Dr. Kouwenhoven said that the data would be largely influenced by the speed used, the time between tests and the time required for the deflection of the galvanometer. Dr. Arnold Roth pointed out that heat breakdowns and dielectric breakdowns are two different things and that a low-loss cable might not have a thermal breakdown but could have an electrical breakdown. Thermal breakdowns always result when an unbalanced thermal condition exists, and for present cable these breakdowns set a use limit much higher than the electrical breakdown limit. With bakelite bushings and similar substances, however, the thermal breakdown value is the limiting element. Dr. J. B. Whitehead indicated the difficulty of measuring absorption values and thought Mr. Marbury had obtained measurements for only the successive intervals used in his cycle of tests and not for the residual charge. The instrument will be valuable, however, he thought, to measure relative absorption values.

In closing the discussion on his paper, Mr. Chase stated that it was essential to start with present conditions in studying distribution and to balance savings from a proposed system against the cost of changeover. It must be realized also that as systems grow much secondary load will be absorbed by the primary system. Any system is good that is economical and gives adequate service, and measured by almost any yardstick the two-phase, five-wire system is equal to or better than other systems. The proposed system was asserted to be standard in every way except as regards the cost and use of Scott transformers, and the two-phase system was in use on many properties.

New Instruments for Transients

Oscillographic Developments with No Time Lag—Method for Solving Network Problems—The Klydonograph in the Field—New Submarine Cable

FIELD investigations of surges on transmission lines made by the use of the klydonograph were discussed in a paper by J. H. Cox and J. W. Legg The klydonograph, which was developed by J. F. Peters, utilizes the Lichtenberg figures to record the characteristics of transient voltages. The arrangement of the instrument to measure short-time intervals is shown in the accompanying illustration.

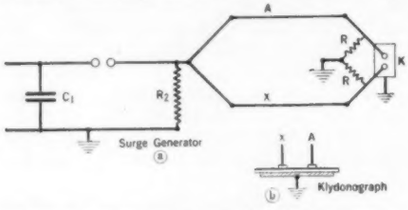
One series of tests was made on a 26,400-volt system consisting of connected cable and open wire. Grounding was varied between solid and 150-ohm resistance. Eighteen surges were recorded during a period of twenty days. One instrument was installed on one phase at a substation and another instrument on the same phase on the open-wire line, 18 miles from the junction of cable to open wire. All surges recorded were on the open-wire line. Of the eighteen surges, seven were alternating, seven were positive and four negative. Two were twice normal voltage, six were one and one-half times normal, and ten were one and three-tenths times normal or less. Eight occurred in clear weather, seven during rain, two in cloudy weather and one during an electrical storm. Two surges twice normal were not caused by a switch operation, but switches were tripped by the disturbances. Of the total, nine surges were caused by switching and one by lightning, no cause being found for the remainder, three of which came in clear weather and five during rain.

Another series of tests was made on a 27,400-volt cable system, with the instrument installed at a pothead in a station with cables extending in both directions. The system was solidly grounded at one point approximately 10 miles from the klydonograph. During 104 days twenty-four surges were recorded. One was one and one-half times normal, one was one and four-tenths times normal, and twenty-two were one and three-tenths times normal or less. Nine occurred in rain and fifteen on clear days. The probable cause of the surge one and one-half times normal was a switch oper-

ation within 3 miles of the instrument. The surge one and four-tenths times normal occurred during switching operations.

A third series of tests was made on a 240-mile, 140-kv. open-wire line with a free neutral. Three instruments each on potentiometers were installed at the sending end, 65.5 miles and 193 miles from the sending end and at the receiving end. One antenna instrument was installed at the receiving end. The duration of these tests was sixty-five continuous days.

During this investigation 124 surges were recorded on the potentiometer instruments. Of these twenty-two were at the sending end, eight at the second



ARRANGEMENT USED TO MEASURE SHORT-TIME INTERVALS

A—Surge generator. B—Two-terminal klydonograph.

station, twenty-seven at the third station and sixty-seven at the receiving end. Fifty-four of these were one and four-tenths times normal or above and were distributed as shown in the accompanying table. Of these fifteen were alternating, caused by three surges; twenty-one were positive, caused by thirteen surges, and eighteen were negative, caused by eighteen surges. Lightning caused nine alternating-current and nine positive. Switching caused nine of those above one and four-tenths times normal.

The steepnesses of a total of 106 surges were recorded on the antenna instrument at the receiving end. Of these, sixteen were simultaneous with records of magnitude on the potentiometer instruments. The maximum was due to one of the oscillating surges caused by lightning and was 28×10^6 kv. per second, or indicated a frequency of 16,000 cycles. The next largest was due to an arcing ground and indicated 24×10^6 kv. per second, or 9,000 cycles. The steepest-front surge was caused by switching and a slope of 14×10^6 kv. per second and was unidirectional.

A fourth series of tests was made on a 270-mile, 220-kv. open-wire line with neutral solidly grounded at four points along its length. Instruments were installed as follows: Three on potentiometers at the sending end; three on potentiometers and one on an antenna at stations 105 miles from the sending end, 140 miles from the sending end and at the receiving end. Tests covered 120 days.

DISTRIBUTION OF SURGES AS RECORDED ON KLYDONOGRAPH

Surge Magnitude Times Normal	Sending End	Second Station	Third Station	Receiving End
3.5 to 4.2	..	..	..	2
2.5 to 3.5	1	..	2	6
2.0 to 2.5	5	3	1	7
1.4 to 2.0	5	3	4	15

The maximum surge recorded was three and two-tenths times normal voltage to ground, while the next was two and seven-tenths times normal. During the tests there were two flashovers of line insulators, neither of which caused a higher voltage than one and nine-tenths times normal.

LOADED SUBMARINE TELEGRAPH CABLE

A speed of more than 1,900 letters per minute, or four times the traffic capacity of an ordinary submarine telegraph cable, has been obtained with the new permalloy-loaded cable from New York to the Azores, according to a paper presented by O. E. Buckley. The copper conductor of this cable is surrounded by a thin layer of the new magnetic material, permalloy, which serves to increase its inductance and consequently its ability to transmit a rapid succession of telegraph signals. Mr. Buckley explained the part played by loading in the operation of a cable of the new type and discussed some of the problems which were involved in the development leading up to the first commercial installation.

OVERVOLTAGE ON TRANSMISSION SYSTEMS DUE TO DROPPING OF LOAD

The manner in which voltage rises when load suddenly goes on the water-wheel-driven generator, or a hydroelectric station, was admirably presented in a paper by E. J. Burnham. Tests and calculations were given in this paper that prove that the voltage rises more rapidly and to a greater extent than has generally been realized.

The time element of overvoltage must be taken into consideration as well as the maximum overvoltage. For example, a piece of apparatus may withstand an impulse voltage of double normal or more, when the duration of the impulse is a fraction of a cycle, but may fail if subjected to a voltage of much less value when applied continuously for several seconds at normal frequency.

It is desirable to design any piece of apparatus so that it has as high a factor of safety against failure as is consistent with an economical design. An attempt should never be made to capitalize the factor of safety by operating a piece of apparatus at voltages above normal. Although the apparatus treated thus may not fail immediately, the insulation or other parts may be weakened, so that by repeating or continuing the conditions of overvoltage, eventual failure is invited.

OSCILLOGRAPHIC SOLUTION OF ELECTROMECHANICAL SYSTEMS

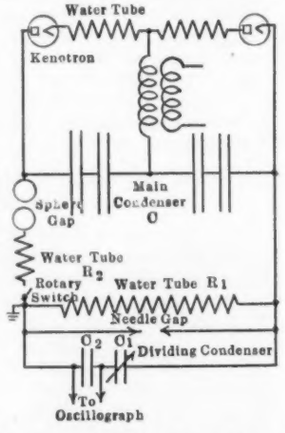
A simple and practical method for investigating certain important classes of dynamic systems, as represented, for instance, by a power system comprising synchronous or induction generating units with prime movers, connected through transmission lines to receiving apparatus of the same character, was described in the paper by C. A. Nickle. The method is to have an equivalent electric circuit solve the problem and the oscillograph plot the solution. The idea is based on the fact that if the differential equation for an electric circuit is identical with that for the dynamic mechanical system in question, then the corresponding electrical qualities can be taken to represent quantitatively the actual mechanical quantities. The equivalent circuit can be easily set up, and oscillographic records of the voltages and currents constitute the plotted solutions. The application of the method to several typical cases was illustrated.

STUDY OF TIME LAG OF THE NEEDLE GAP

The study of high-voltage, steep-wave-front transients is difficult from the experimental standpoint because of the very short intervals of time involved. Owing to the improvement of the cathode-ray oscillograph in recent years, a device is now available by the use of which transients occuring in times as short as one-billionth of a second or less may be photographed. In a paper describing this instrument K. B. McEachron and E. J. Wade used an oscillograph developed by Dufour in France with which a brief study was made of the time lag of needle gaps and of a needle to a plane.

A photographic film is placed inside the tube so that the electrons impinge directly on the film. The wave is drawn out along a time axis by the combined action of a sweeping motion and a perpendicular oscillating motion imported to the electron stream by the action of proper electromagnetic fields.

In disucssing the paper by Mr. Nickle, R. E. Doherty asserted that the method was a general one applicable to many electrical problems heretofore solved only with great difficulty by means of mathematical equations. The new method used simple principles of physics only to state the problem in terms of an electric circuit and then required only an oscillograph to reach a solution. R. D. Evans said that the method could not be used for many stability problems as often the power



ARRANGEMENT OF APPARATUS FOR DUFOUR OSCILLOGRAPH (MCEACHRON AND WADE)

is not directly proportional to the phase angle. It will apply, however, to hunting conditions and to the solution of a part of the stability problem, as, for example, the receiving network. He told of another development along similar lines which represented the electrical problem by a mechanical system that could be used in the solution of stability problems since it conformed to the actual trigonometric relations.

E. E. F. Creighton remarked that the new oscillograph and the Nickle method

offered engineers two new tools which should enable them to solve problems of twenty years' standing. The combination of an instrument for accurately recording high-freuency phenomena and a method for attaining an oscillographic solution to circuit problems opened the way to many advances in the art. J. R. Golladay said that it was very difficult to measure the time lag of arcs with accuracy and pointed out that the McEachron paper presented data and conclusions at variance with the conclusions of Professor Peterson and others. D. W. Roper thought that the new oscillograph and the klydonograph should prove useful in studying cable troubles. He pointed out that only 40 per cent of cable failures occur from losses and that many failures occur because of surges and transients which are little understood and difficult to measure. Mr. McEachron stated that experiments with the klydonograph would indicate that the size of the figure is appreciably affected by the magnitude of the voltage. There may be reflection in circuits which would make the instrument calibration inaccurate. L. T. Robinson pointed out that H. J. Ryan developed the cathode-ray oscillograph many years ago. He said that it had its limitations because of the limited time for exposure. In his opinion the klydonograph needs more study to determine its realm of application and what it measures accurately.

In discussing the new submarine cable, W. C. Peterman asserted that another improved cable had been ordered to cover New York-to-London traffic. This new cable would have a speed up to 75 cycles per second, or about 2,400 letters per minute, and would have a traffic capacity equivalent to the present seven transatlantic cables. This new cable and the Azores cable will be worked on a six-channel multiplex system and they open a new era in cable telegraphy. E. B. Craft observed that it took years of effort to develop the whole cable and that the Western Union had great courage in making an enormous investment based only on laboratory data and conclusions.

Mr. Nickle, in closing the discussion on his paper, said that it covered accurately only those problems involving linear differential equations but can be used to great advantage to determine certain factors essential to the solution of stability problems. J. H. Cox stated that the klydonograph had been developed for line studies and not much work had been done at frequencies of less than five microseconds. He thought it was necessary to set up calibrating circuits very carefully to avoid circuit effects which would produce errors and concluded that a definite voltage produces a definite figure in the range within which the instrument had been used. O. E. Buckley pointed out that an unusual phenomenon had been discovered in connection with wrapping the permalloy tape on the copper. The air gaps between turns seemed to affect reluctance little and the lines of force were found to be not circles but helices which followed the tape for perhaps forty turns and then slipped back. A very decided longitudinal magnet effect was thus indicated.

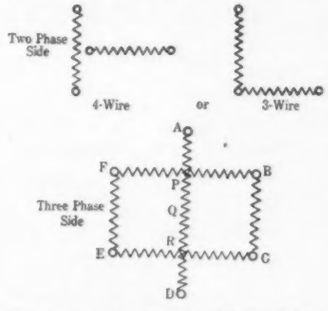
Transformer Reactances Studied

New Studies of Leakage Reactance—Multiple Winding Transformers Discussed—Effect of Superimposed Excitation on Iron

THE distribution of harmonics in single-phase transformers and in three-phase banks of single-phase transformers was discussed in a paper by O. G. C. Dahl. Two-winding and three-winding transformers where the harmonic current exists in only two of the windings were also considered. The formulas for the distribution of harmonic currents between primary and secondary circuits have been worked out by Mr. Dahl. Some data from laboratory tests on small experimental transformers and also some data and results from tests on a bank of three 2,100-kva., 110,000/22,000/2,300-volt transformers were presented.

Two-Phase to Six-Phase Transformer

A new transformer connection of 100 per cent apparatus economy for transformation from two-phase to six-phase and vice versa was described by A. Boyajian. The connections are shown in the accompanying illustration.



Two-Phase to Diametric Three-Phase or Six-Phase Transformers (Boyajian)

Three-phase side, voltages:
AD-BE-CF—100 per cent
AP-PQ-QR-RD—25 per cent
BC-PR-FE—50 per cent
BP-PF-CR-RE—43.3 per cent
Current in lines—100 per cent
Current in AP-PQ-QR-RD—100 per cent
Current in BC-FE—50 per cent
Current in BP-PF-CR-RF—86.6 per cent

It may be noted that the six-phase side may also be considered a diametric three-phase system, since any diametric three-phase device may be operated from it. In the paper the merits of this connection from various standpoints are compared with those of the T and the double-T transformer connections.

Separate Leakage Reactance of Transformer Windings

An experimental method of determining the leakage reactance of transformer windings as a separate reactance was described by O. G. C. Dahl. The method is applicable only to three-phase banks of three identical transformers and makes use of the third harmonic electromotive force and current, which are introduced into the windings by the inherent magnetizing characteristics of the iron.

The principle of the method is as follows: If sinusoidal voltages are impressed on a Y-delta-connected bank of transformers, the third harmonic component of the magnetizing current will be confined to the delta, where it appears as circulating current. If the transformers are perfectly balanced and there is no external load on the secondary, no current other than the third harmonic and its multiples can exist in the delta. Usually the ninth and fifteenth harmonics, etc., are negligible and need not be considered. The third harmonic electromotive force induced per phase of the delta is just balanced by the triple-frequency impedance drop due to the circulatory third harmonic current. The problem is then to measure with precision the proper third harmonic electromotive force and current, which, by simple division, will give the desired triple-frequency leakage impedance.

The method may be used both with two-winding and multi-winding transformers. However, it is particularly convenient when the transformers have more than two windings. The results obtained with this method warrant the conclusion that the separate leakage reactances may be obtained with sufficient accuracy for engineering purposes.

Resolution of Transformer Reactance

The resolution of the leakage reactance of a pair of windings into the individual reactances of the two windings is indeterminate unless referred to a third winding and it varies with the object in view when making the resolution, according to the views expressed by A. Boyajian in his paper on this subject. If the object is the influence of exciting current on performance, the problem is converted into a three-winding transformer problem by conceiving of the exciting current as produced by a (fictitious) load in a (fictitious) third winding. Mr. Boyajian pointed out that the resolution of leakage reactance into individual reactances is possible only in the case of three windings, and that therefore in a transformer with three real windings and a fictitious exciting-current-load winding, constituting the equivalent of a four-winding transformer, the simple resolution fails, each winding having a different individual leakage reactance when associated with one pair of the remaining windings than when associated with another pair.

Excitation Losses in Iron

The results of wattmeter measurements of iron losses in a small experimental reactor designed for alternating-current and direct-current excitations were described in a paper by O. E. Charlton and J. E. Jackson. The work indicated that the iron losses of a direct-current-excited reactor are not excessive. For high alternating-current saturations, such as would be used in shunt reactors for voltage regulation on a transmission line, the iron losses proper may

even be decreased. However, no scheme has yet been discovered for eliminating the necessary evil of the double-frequency circulating current, and its copper loss must really be charged up to the iron. This loss, however, may be made as small as desired by using sufficient copper, since for a given core the double-frequency current is a function of the direct-current excitation and by its circulation tends to cut down the voltage that produces it. Its limiting peak value is the value of direct current if it all flows in the direct-current circuit.

A great deal of discussion took place as to methods of separating the leakage reactance of transformer windings. The question seemed to be whether it was possible to get the leakage reactance of each transformer winding by itself. Unless referred to a definite quantity such as the exciting current or a third winding it is impossible to resolve the reactance, according to several of those taking part in the discussion.

R. G. McCurdy said that if we have a definite ratio transformer, the reactances can be found. He did not agree with Mr. Boyajian that leakage reactance was indefinite. Prof. V. Karapetoff said that the leakage reactances of windings are quantities that appear in the equivalent diagram of a two-winding transformer and as such can be solved. With three or more windings the question of the division of load enters, and therefore the reactance of each winding must be referred to the particular load distribution which is being considered.

The practical importance of the solution of this problem was pointed out by L. P. Ferris. In particular he referred to the effect of a power line on a near-by communication line. Here the question of the third harmonic current appears. The separation of this third harmonic current is very definite, but the problem is to predetermine its distribution and effect in the transformer and power line. He said that the interest being shown by the manufacturing companies and by the universities is very gratifying.

John D. Ball recited his early investigations of the superimposition of direct current and alternating current on reactances and the resulting losses in the iron. He declared that the results given in the paper by Messrs. Charlton and Jackson should be considered only with the particular connections and apparatus used by the authors. In his opinion it is absolutely necessary to use a potential coil for getting measurements, and this was not done in the paper referred to.

Letters from Our Readers

Cable-Test Methods Arbitrary

To the Editor of the ELECTRICAL WORLD:

In a letter appearing in your issue of June 13 R. W. Atkinson comments on the difference between European and American practice in the measurement of dielectric losses and power factor in high-tension cable. Mr. Atkinson very properly emphasizes the marked difference in the results which the two procedures give and the necessity for bearing in mind the difference in conditions under which the measurements are made when comparing European and American data. However, I question if much can be said in favor of the European method, especially for American conditions of installation and operation.

Dielectric-loss and power-factor requirements in specifications are primarily for the purpose of checking the quality of the insulation and not for the purpose of getting data that will be applicable to the cable later when it is in service. It is essentially an arbitrary test for specification purposes and not for operating purposes, in the same way that the temperature-rise standards for electrical machinery in the A. I. E. E. rules are for the purpose of rating in connection with specifications and not necessarily for use in connection with operating.

Of course, when a test of this class can be so made that the data will serve both purposes, so much the better. But the test under discussion cannot be so made, for the simple reason that there is no standard operating condition—the difference between the temperature of the copper and that of the sheath varying with the method of installation, the thickness of insulation, the character of the soil, etc. Since an arbitrary standard difference of temperature would have to be selected which could not be applicable to the majority of installations, it is better to have the uniform temperature throughout the insulation as is universally done in this country. This procedure has the following advantages:

1. Power-factor measurements of all forms of cable are directly comparable, irrespective of thickness or shape of insulation. This is not possible when the conductor only is heated, because the temperature distribution will differ in different cables.

2. It is a more exact procedure—an important consideration when dealing with acceptance or rejection of material under specifications.

3. The highest possible values are obtained. We then know that the values under any installation or operating condition would be *less* than the test values.

4. Greater simplicity and convenience.

Electrical Testing Laboratories,
New York City. F. M. FARMER.

Experience with Lightning

To the Editor of the ELECTRICAL WORLD:

Regarding the article on page 204 in the January 24, 1925, issue of the ELECTRICAL WORLD by R. W. Pruesser on "Experiences with Lightning Trouble in Austria," the following comments based on observations and experience in this country may be of interest.

In all the experience with lightning on line insulators we have never seen an insulator melted by the lightning stroke. However, it has often occurred that the dynamic flashover following the lightning stroke will blister the glaze or even partially melt down an insulator, especially if the relays on the lines are set rather heavily. The effect described of the lightning upon insulators I would attribute to defective porcelain, probably pin cracks or heat cracks, and "secondary discharges more than a kilometer away" to the breaking through of dynamic surge currents at such locations. My conclusion is borne out by the previous writer's comment that parallel lines were not affected.

The "erecting of high lightning conductors close to the lines" is rather vague, but I take it that Mr. Pruesser means that vertical conductors on isolated poles, such as "lightning rods," shall be placed at intervals along the line. What possible effect these could have in the protection of a line against lightning troubles is rather a mysterious quantity as they certainly would in no way effect the release of the bound charge on the line and would not to any extent reduce its amount. Neither would they have any great effect on the localizing of direct discharge because, as F. W. Peek, Jr., has pointed out, a point terminal is not so fast as the smooth conductor surface of a line wire. For this reason alone I would not expect the lightning rod to be very effective.

Mr. Pruesser speaks as though the presence of trees near the line were a hazard from the viewpoint of lightning, whereas the opposite condition is a fact.

Ever since the Middle Ages it has been recognized that trees, and especially trees with pointed leaves, such as "Lombardy poplars," are among the best protectors against lightning discharge. However, I can heartily agree to the removal of trees near transmission lines, entirely with the view of reducing the chance of dead branches blowing across the lines.

Regarding the last paragraph of Mr. Pruesser's article, it would appear that he has to a large extent placed his faith in the unknown rather than in the demonstrable facts of science. Although I can heartily agree that surface water seems to bear an immediate relation to the lightning hazard of a given section, I can very assuredly state that it is because of the storm center following such surface water. I cannot conceive how a subterranean waterway below such a bog or thoroughly good conducting surface could possibly affect lightning area.

D. D. CLARKE,
Electrical Engineer.

Kansas City Power & Light Company,
Kansas City, Mo.

Insulation Power Factor Too Low

To the Editor of the ELECTRICAL WORLD:

In my letter printed in your issue of June 13, entitled "Dielectric Losses in Cables," the ordinates of the graph are incorrect as printed. The zero power factor should be one-half, one should be one and one-half, etc. In other words, one-half should be added to each ordinate.

R. W. ATKINSON.

Perth Amboy, N. J.

Comments on Compensation

To the Editor of the ELECTRICAL WORLD:

From time to time I have read your editorials on compensation in the utility field with a nod of approval, living "in hopes" that executive compensation in that industry would some day approach reasonably near to that which is offered, sometimes for less effort and exertion, in the industrial, the manufacturing or even the jobbing field. I have been tempted before to comment on these editorials, but have refrained, believing that recognition of the proper scale of compensation would soon be forced.

Your editorial in the May 23 issue, entitled "Penny-Wise Public Relations," however, makes the temptation to comment on my part irresistible. I happen to be manager in a town where the citizens built a municipal plant before I took the position and can truthfully say that this competing plant would never have been built had the owners of the private company paid a salary sufficiently attractive to bring them the services of a competent executive. As it is, the privately owned company has lost in a few years of competition about $200,000. Instead of paying their executive $3,000, they could have paid $10,000 and made for themselves $40,000 a year.

Yes, it is a joke when the central-station company you refer to offers $1,800 for the services of a man who can win the public good will. I wish to commend your stand and am convinced that, with the situation as it exists, the holding companies will have to raise their managers' salaries from $3,000 or $4,000 to $10,000 or $12,000—and they will make money by doing it.

A MANAGER.

Placing the Brackets in the Home

To the Editor of the ELECTRICAL WORLD:

Your editorial in your issue of May 9, entitled "Utilitarian Wall Brackets Are Much Needed in the Home," was very good and right to the point. The problem of wall brackets for kitchen sinks and at mirrors is a simple one, easily understood by any layman. But how about wall brackets in living rooms, dining rooms and bedrooms?

I could point to any number of homes, both old and new, where the locations of whatever wall brackets are used deserve observation. Out of it all I have been trying to decide just "what, how or which" lay behind the exact placing of these wall brackets for lighting and ornamental purposes. There is every conceivable combination of location with respect to doors, windows, wall space and convenience outlets. It seems to me that here—and perhaps elsewhere, too—there is altogether too much idea of placing the brackets to suit the electrical contractor or to keep the cost down for the general contractor and not enough consideration of the actual needs of those who are going to use the home.

Are there any general underlying principles that could be applied to the location of wall brackets in living rooms, dining rooms and bedrooms and which could be put before the public and those of the electrical fraternity who appear to need education on the subject? —and, goodness knows, most of us need it!

G. W. WESTON,
Secretary-Manager.

Kansas City Electric Club,
Kansas City, Mo.

Operating Costs of Diesel Plants

To the Editor of the ELECTRICAL WORLD:

In the April 25 and May 16 issues of the ELECTRICAL WORLD, under "Letters from Our Readers," there have been some comments in regard to the operating costs of Diesel plants in small towns, these comments questioning the costs given in an article previously printed. Without making any comments on the original article, but in order to present some figures for the benefit of those interested, I submit the tabulation herewith. The station referred to is the Grove City (Pa.) municipal electric plant, serving a population of 5,700 and with 1,401 customers. There are installed three solid-injection, six-cylinder, four-cycle, 348-brake-hp. units connected to 300-kw., three-phase, 60-cycle, 2,300-volt generators. Fuel oil costs 7.25 cents, lubricating oil 0.45 cent and water 0.15 cent per 1,000 gal. The excess-water bill shown in the table for April was due to water-tower repairs.

FRANK H. POEHLMAN,
Superintendent.

Grove City Borough,
Grove City, Pa.

OPERATING COSTS OF 900-KW. DIESEL-ENGINE PLANT

Month	Salaries	Fuel	Lubricating Oil	Repairs	Water	Interest and Depreciation	Total	Output, Kw.-Hr.	Cost per Kw.-Hr.
January	$525.00	$1,573.25	$114.30	.....	$26.10	$768.00	$3,006.75	219,600	$0.0136
February	525.00	1,171.60	112.05	$52.81	72.81	768.00	2,702.41	187,900	0.0143
March	525.00	1,321.60	117.45	15.59	61.58	768.00	2,809.22	222,700	0.0121
April	525.00	1,189.73	104.40	64.45	303.30	768.00	2,954.88	167,800	0.0176
Total	$2,100.00	$5,256.18	$448.20	$132.85	$463.93	$3,072.00	$11,473.16	$798,000	$0.0144

Commercial Activities and Public Relations

More and Better Business Campaign

Public Service Company of Northern Illinois Merchandise Sales $115,784.16 in Three Months—Bonus to Employees for Closed Prospects—Details of Plan

THE Public Service Company of Northern Illinois, with general offices in Chicago, inaugurated on Dec. 1, 1924, a "more and better business campaign," the object of which was to enlist the interest and co-operation of all employees of the company in stimulating sales of electrical merchandise. The plan and activity are designed for continuous operation throughout the year. Results of the first three months' operation of the plan have been most encouraging. During the first ninety days the total business obtained as a result of the campaign amounted to $115,784.16.

TERRITORY WHERE PLAN IS USED

The territory served by this company about Chicago covers more than 5,200 square miles, in which are located 210 communities wherein the company serves a total of 140,000 electric residential meters.

The company organization is divided into twelve districts, in each of which there is a district manager who reports to the general office, and a new-business manager who reports to the district manager. The new-business manager promotes all new business activities and manages those of the thirty stores that are within his district.

In the 210 communities served, there are but two daily newspapers suited to advertising purposes. It is therefore necessary to resort to weekly newspapers, direct-by-mail broadsides and house-to-house canvass to produce volume of sales of energy-consuming devices.

The activity was launched at a meeting of the general managers called by the president to explain the desire of the company to increase its volume of business. The vice-president in charge of sales presented the details of the campaign. Each district was allotted a quota and lieutenants were sent to address district meetings. A system of bulletins was prepared and posted in prominent places calling attention to specific appliances.

A vest pocket manual was drawn up showing pictures, prices, cost of operation and other information pertaining to the merchandise sold by the company. Items were arranged in the manual according to the various departments of the home and all necessary information was listed to enable any employee of the company to give a satisfactory description and opening sales talk on any appliance carried.

Charts were posted showing the standing each day of the district. The employees of the sales department were urged to encourage fellow employees to send in prospects. "More and Better Business" prospect cards were furnished each employee, who filled in the customer's name and address, checking off the items that the customer was interested in and signing his name before turning the prospect card over to the sales department, which completed the sale.

The bonus for the employees' interest in the sale was paid the first and fifteenth of each month. Where sales were made from the prospect cards turned in the bonus paid was as shown in the accompanying table.

Concrete results from the first three months of operation of the campaign have been as follows:

Prospect cards turned in	5,153
Number of sales closed from prospect cards	2,389
Per cent of sales to prospect	46
Total amount of sales	$115,784.16

SCHEDULE OF BONUSES PAID EMPLOYEES FOR PROSPECTS RESULTING IN SALES

Electric Merchandise

Curling iron	$0.25	Sewing machine	$1.00
Dishwasher	1.00	Sewing machine motor	.25
Fan	.50	Percolator	.25
Grill	.25	Radiator	.25
Hair drier	.25	Range	3.00
Heating pad	.25	Servel refrigerator	5.00
Hot plate	.25	Toaster	.25
Iron	.25	Coffee urn	.25
Soldering iron	.25	Vacuum cleaner	1.00
Ironing machine	2.00	Vibrator	.25
Portable lamp	.50	Waffle iron	.25
Table lamp	.50		
Washing machine	2.00		

Electric Lighting

Billboards and building floodlighting, 10 cents per 100 watts, connected minimum $1.

Kitchen unit, 50 cents.

Store interior lighting, store window lighting, factory lighting, 10 cents per 100 watts connected original, additional or increased load.

Residence lighting, wiring old houses adjacent to company lines, $1.50.

Replacement of single convenience outlets with duplex outlets, 10 cents each.

The Daylight Kitchen Unit
This unit is of porcelain enamel steel in one piece.
A large diffusing Inland glass bowl is held firmly in place with three adjustment lock screws.
A 100 or 150 watt lamp.
A plug-in switch to control your light combined with a convenient outlet for attaching appliances such as irons, toasters, or grills.
Recommended by our lighting engineers as the most complete and efficient unit on the market.
We are so confident that this superior light in your kitchen will satisfy that we will install this unit for a thirty day trial.
After a month's trial, if you are not pleased, we will take it back, and replace the old fixture.
Could we make you a more liberal offer?
This kitchen unit may be obtained on small monthly payments.
This Offer is Limited
Make your Kitchen Bright Light and Cheerful
With this Wonderful Unit
there is the advantage of an additional convenience outlet for use of your appliance — the iron, toaster, percolator, fan, etc.
It is easy to iron from an overhead outlet.
Sign and mail coupon for "FREE THIRTY DAY TRIAL OFFER"
FREE Thirty Day Trial Offer
A SECOND OFFER

LACK OF ADEQUATE DAILY NEWSPAPERS REQUIRED EXTENSIVE USE OF THIS TYPE OF DIRECT-BY-MAIL ADVERTISING

Of the sales made from prospect cards 40 per cent were for cash and the majority were of kitchen-lighting units, electric irons, electric refrigerators and other large energy-consuming devices.

As the campaign continues, it is felt by those in charge that the education given the regular employee and the loyalty displayed have been of more benefit than the profit from the sales or the load secured for the company's lines. Even though employees have always been able to purchase appliances at reduced prices, the interest created by the "more and better business" campaign has increased the use of appliances in the homes of employees to a marked degree.

[4]
Electric Ranges
SIMPLEX
65 Cash price $165.00, deferred $174.90, down payment $18.94, monthly payments $13.00.
77 Cash price $205.00, deferred $217.30, down payment $25.30, monthly payments $16.00.
LINDEMAN & HOVERSON
813 Cash price $220.00, deferred $233.20, down payment $29.20, monthly payments $17.00.
UNIVERSAL
E93 Cash price $165.00, deferred $174.90, down payment $17.50, monthly payments $14.00.
E91 Cash price $200.00, deferred $212.00, down payment $20.00, monthly payments $16.00.
Lighting Equipment
DAYLIGHT KITCHEN UNIT
Cash price $9.00, deferred price $9.54, down payment $1.00, monthly payment $1.00.
Electric Refrigeration
THE SERV-EL
Cash price $645.00, deferred price $683.70, down payment $57.00, monthly payment $57.00.
[5]

SHEETS FROM THE VEST POCKET MANUAL DISTRIBUTED TO EVERY EMPLOYEE

John G. Learned, vice-president in charge of sales, and H. B. Fisk, manager of retail merchandise sales of the Public Service Company of Northern Illinois, are jointly responsible in planning and carrying out this sales activity.

American Legion Helps Finance Street Lighting

WHEN the proposition for improving the street lighting of Neola, Iowa, came up for consideration recently, it was found that the general fund of the town, which has a population of only 900, was sufficient to pay for only half of the installation of the type desired. Thereupon the American Legion post of Neola raised the other 50 per cent necessary for a white-way installation of thirty 200-watt and 300-watt multiple units. As the general fund of the town was exhausted when it had supplied 50 per cent of the cost of the new equipment, the American Legion also took upon itself the actual installation of the new lighting system.

Third Electrical Home Draws 7,028 People

ELECTRICAL HOMES as working demonstrations continue to be one of the best mediums for impressing upon large numbers of the public the value of household electrical conveniences. Such an exhibition, the third of its kind in Denver, has just been concluded by the Electrical Co-operative League of that city. During the ten days that the home was open 7,028 adult visitors were received, according to S. W. Bishop, manager of the league.

Even though this home was located further from the heart of the city than the previous ones, marked interest continued throughout the exhibition to the extent that the builder and the merchant who furnished the interior of the house kept the home on display a week longer than the time originally provided by the electrical people.

One of the features of the home was cove lighting in the living room, the first home of its size in Denver to be equipped with a total indirect system supplemented with bracket lights properly shaded. A total of eighty-eight outlets were installed, of which twenty-one were convenience outlets. The home was also wired for radio. Included in the twenty-eight electrical appliances installed in the house were the range and refrigerating equipment.

Costs and Results of Public Utility Advertising

AVAILABLE figures and estimates of public utility advertising reveal the remarkable development within a comparatively few years of this activity of utility operation. Investigation by E. Paul Young of the Public Utilities Advertising Association shows that in 1923 the advertising expenditure was more than $20,000,000 and that in 1924 the amount was over $23,000,000, and from data submitted the estimate for 1925 is placed at more than $25,000,000.

The data collected by the association indicate that too many companies are inclined to follow closely a proportion of increase in their advertising each year based on the previous year's expenditure. Reports show 51 per cent of companies budgeting according to previous year's advertising expenditure, 27 per cent according to previous year's gross earnings and 22 per cent on estimated gross earnings for present year. More than 60 per cent of companies reporting showed advertising increase in direct proportion to gross earnings, and of the remaining 40 per cent the majority reported advertising expenditure increasing in greater proportion than gross earnings increase.

The average percentage of gross earnings set aside for the advertising budget of various types of utilities, showing also the lowest and

TABLE I — ADVERTISING APPROPRIATION IN PER CENT OF GROSS INCOME

	Average	Lowest	Highest
Electrical	0.35	0.05	1.5
Transportation:			
Interurban and buses	1.33	0.25	2.3
Street railway and buses	0.39	0.19	1.0
Gas	0.45	0.15	1.2
Water	0.05	0.05	0.05
Communication	0.8	0.25	1.2
Merchandise (net sales)	3.45	1.1	5.18
Securities ($100 par sales)	0.78	1.5	0.25

DENVER'S THIRD ELECTRICAL HOME

highest percentage, is shown in Table I.

The greatest proportion of the advertising expenditure was represented by newspaper advertising. Table II shows the average expenditure for newspaper, direct mail, outdoor and miscellaneous classifications.

It is evident that the amount of newspaper space used by utility companies has increased greatly in just a few years. Through the fine direct results obtained from newspaper advertising on security and merchandise activities, the utilities have renewed their appreciation of the value of newspaper advertising. This has changed the attitude of many utility operators from the old idea that a utility must advertise in a newspaper in return for its good will to the realization that advertising money spent in newspapers is more than justified through results accomplished.

TABLE II—PER CENT OF ADVERTISING EXPENDITURES IN VARIOUS MEDIA

	Newspaper	Direct Mail	Outdoor	Miscellaneous
Electrical	57	17	17	9
Gas	67	13	13	7
Street railway and buses	59	10	12	19
Interurban and buses	56	9	5	30
Communication	70	14	2	14
Good-will or public relations	59	18	12	11
Merchandise	63	19	9	9
Security sales	71	17	2	10
Average	63	14	9	14

A Friendly Street Sign for Construction Work

TRENCH guards of the type shown here are used by the Twin State Gas & Electric Company, Bennington, Vt., when construction work cuts down the usable area of highways. Signs of this kind contribute far more to good public relations than the old-time "Keep Out" and "No Passing" injunctions.

Electric Refrigerator Service Costs

WIDE differences in the cost of servicing domestic electric refrigerators are being experienced by various central-station companies throughout the country, and it has been impossible apparently to arrive at what might be considered a fair allowance for the annual costs of this work per machine. W. E. Clement of the N.E.L.A. electric refrigeration committee, in tabulating these figures from central-station companies, found that service costs ranged from as low as $3.39 to $24.39 per machine per year, each of these figures, of course, representing extreme conditions.

A summary of the number of service calls, their nature and cost is given in the accompanying tabulation. Because of the wide variation in cost of servicing as reported by different companies, no attempt has been made to present an average yearly figure. It was felt by this committee, however, that under present conditions a service cost of between $12 and $15 per year would be adequate.

It has been pointed out that this cost decreases as the number in use in a given territory increases and service men become more proficient in diagnosing troubles and making repairs. Continuous improvement in details of design and construction of the machines themselves have and will tend to lower the cost of servicing.

SUMMARY OF ELECTRIC REFRIGERATOR SERVICING CAUSES AND COSTS FROM DATA COVERING 353 MACHINES

Machine Data		Total Calls	Pressure Control or Thermostat			Belts		Expansion Valve			Idler Pulley		Compressor		
Number	Machine		Adjust	Repair	Replace	Loose	Replace	Stuck	Adjust	Replace	Repair	Replace	Stuck	Repair	Replace
13 Machines	Kelvinator	66	3	..	1	4	9	..	3	1	2	..	..	..	1
17 Machines	Kelvinator	105	15	1	10	19	13	..	11	2	4	..	..	2	2
262 Machines	Kelvinator	411	96	16	7	8	30	3	37	4	19	4	5	..	10
10 Machines	Kelvinator	78	13	..	27	10	5	..	1	3	..	..	1	..	3
5 Machines	Kelvinator	12	..	1	..	..	2	1	..	..	1	..	..	1	..
General summary—307 machines		672	127	18	45	41	59	4	52	10	26	4	6	3	16
Percentage calls to total		100	18.92	2.68	6.71	6.11	8.79	0.60	7.75	1.49	3.87	0.60	0.89	0.45	2.38
12 Machines	Servel	16	4	..	1	2	7	..	..	..	..	..	..	..	..
12 Machines	Servel	70	1	..	..	..	5	..	1	..	1	..	..	..	1
General summary—24 machines		85	5	..	1	2	12	..	1	..	1	..	..	..	1
Percentage calls to total		100	5.89	..	1.18	2.35	14.12	..	1.18	..	1.18	..	..	..	1.18
22 Machines	Electro-Kold	77	9	2	..	3	6	2	21	..	..	..	..	4	..
Percentage calls to total		100	11.69	2.60	..	3.90	7.79	2.60	27.28	..	..	..	..	5.19	..

Machine Data		Motor		Miscellaneous Data									Cost Data			
Number	Machine	Repair	Replace	Oiled Motor	Oiled Compressor	Fuses	Defrost	Useless	Routine	Leaks	Mixture	General	Total Cost	Average Cost per Call	Average Cost per Mo. per Mach.	Prorated Cost per Year per Mach.
13 Machines	Kelvinator	4	1	5	3	1	3	5	19	1	..	..	$258.30	$3.913	$2.033	$24.396
17 Machines	Kelvinator	4	3	..	..	..	2	10	..	3	1	3	.....	.....	.....	.....
262 Machines	Kelvinator	28	14	..	16	20	4	60	..	3	6	21	3,631.32	8.835	1.154	13.84
10 Machines	Kelvinator	13	..	..	..	..	..	2	..	..	..	..	78.00	1.00	0.283	3.39
5 Machines	Kelvinator	2	..	..	..	..	..	1	..	3	..	..	25.94	21.45	0.489	5.86
General summary—307 machines		51	18	5	19	21	9	78	19	10	7	24	.....	.....	.....	.....
Percentage calls to total		7.60	2.69	0.75	2.83	3.13	1.34	11.62	2.83	1.50	1.04	3.58	.....	.....	.....	.....
12 Machines	Servel	..	..	1	..	..	..	..	..	..	..	..	.....	.....	.....	.....
12 Machines	Servel	..	..	..	..	..	..	..	55	5	..	1	105.00	1.50	1.50	18.00
General summary—24 machines		..	..	1	..	..	..	..	55	5	..	1	.....	.....	.....	.....
Percentage calls to total		..	..	1.18	..	..	..	..	64.74	5.89	..	1.18	.....	.....	.....	.....
22 Machines	Electro-Kold	..	..	2	..	6	..	12	..	5	..	5	103.80	1.348	0.725	8.70
Percentage calls to total		..	..	2.60	..	7.79	..	15.59	..	6.49	..	6.49	.....	.....	.....	.....

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Design and Manufacture of Blading for Steam Turbines.—L. L. SMITH.—This is a descriptive article dealing with the gradual development of the manufacture of turbine blades, the requirements to be met and current methods of quantity production. It is copiously illustrated.—*Electric Journal*, May, 1925.

Superpower in Italy.—In connection with the article on "Cheap Power and Hydro-Electric Development" in the April number attention is called to a report by the Edison group of associated companies in the north of Italy recently published in *l'Energia Elettrica*. The following items are abstracted from the statistics quoted:

	Kw.
Total power connected to the network	455,000
(a) Water power owned by the group	280,000
(b) Steam power owned by the group	63,000
(c) Obtained from other groups	112,000
	Kw.-Hr.
Total output delivered to network	1,744,000,000
From (a) above	1,333,000,000
From (b) above	81,000,000
From (c) above	330,000,000
Total output sold to consumers, outside of the group	1,472,000,000

Financial data are also given, but because of their uncertain significance, in view of the depreciated currency, are not here reproduced. On the basis of plant installed the load factor has the high value of 49.5 per cent. Taking the maximum load instead of the installed capacity, it is estimated to exceed 70 per cent. The extent to which interconnection helped to bring this about is shown by the fact that more than 500,000,000 kw.-hr. was used between companies—i.e., about 30 per cent of the output. Construction is going on at a rate that will double the output in three years.—*World Power*, May, 1925.

Low-Head Power Plant Designed for Typical Mid-West River.—E. L. CHANDLER.—An illustrated description is given of a 1,500-kva., three-phase, 60-cycle plant, with a normal operating head of 25 ft. Attention is devoted mainly to hydraulic and structural rather than to electrical features.—*Engineering News-Record*, May 7, 1925.

Generation, Control, Switching and Protection

Self-Synchronizing Alternator.—This machine, known as the "Hunt," is in effect a combination of an induction and a synchronous generator in a single unit. It is two-thirds the former and one-third the latter, the synchronous element supplying power and magnetizing currents to the non-synchronous element. This arrangement is said to result in a machine which does not have to be synchronized before it is paralleled with other machines and which will run satisfactorily in parallel under conditions prohibitive with ordinary alternators. The article explains the principle, qualitatively, and indicates the circuits of the new machine.—*Electrician (England)*, May 15, 1925.

Maximum Current Strength in Earthing Electrodes.—L. P. PODOLSKY.—The author demonstrates that three different cases are to be considered in designing protective earth devices: (1) where operating conditions force the service men to come into contact constantly or for long period with earthed casings, frames or metallic parts connected with them electrically; (2) where chance contact is possible; (3) where, though only chance contact is possible, a large number of men are subject to this chance.—*Elektrichestwo*, No. 3.

Losses Due to Eddy Currents in Electric Machines.—J. WENNERBERG.—This contribution to the subject of extra losses in alternating-current machines is a continuation of the author's previous articles in this magazine, and deals with the losses that occur in the end windings. The author employs the same approximate method used in previous articles. Other articles are still to come.—*Teknisk Tidskrift (Swedish)*, *Elektroteknik*, May 2, 1925.

Transmission, Substations and Distribution

Splitting of Conductors in Transmission Lines.—L. E. MASHKILLEISON.—The splitting of conductors in transmission lines considerably alters the electric properties of the lines and their mechanical construction. The paper here noted gives the formula and experimental data for the calculation of constants for transmission lines with split conductors. The influence of splitting on the self-induction, the capacity, the potential gradient on the surface of the conductor and the corona discharge is studied. The result obtained shows that in many cases the splitting of conductors may appreciably reduce the expenses of transmission.—*Elektrichestwo*, No. 3.

Calculation of Wooden Poles.—H. NEULAT.—A mathematical formula is derived, giving a simple relation between the height, the taper, the top diameter and the permissible maximum horizontal pull of a line for wooden poles. A choice is given between safety factors of three and five. A wind pressure of 72 kg. per square meter and a breaking stress of 550 kg. per square centimeter of the pole are assumed. To avoid mathematical calculations and to arrive quickly at the result sought, the author has constructed two curve sheets for the two safety factors, from which can be read directly the maximum permissible horizontal pull for poles of any given height and taper. A correction factor is given for double poles.—*Revue Générale de l'Electricité*, April 18, 1925.

Power Distribution in Bavaria.—A. MENGE.—From the large hydro-electric power plant at Walchensee, in southern Bavaria, which was put in full operation in January, 1924, a 100-kv. transmission system extends northerly which covers almost the entire state, the total length of all the transmission lines being 580 miles. On this system thirteen inclosed transformer substations are connected, some of them containing rotary condensers. In three of these stations the oil switches have been sunk into the ground, so that only their covers with high-tension leads are visible. This gives an unusual arrangement, but one which, it is claimed, is very advantageous. All switches used on the system are of the resistance-step type. Some 16,000-kva., three-phase transformers are shown which had to be built with five-legged cores to keep shipping dimensions down to a minimum. In the chief dispatcher's office, about 40 miles from the power house, is installed a very elaborate glass switchboard of the phantom type, on which 2,000 small electric lamps indicate the condition of every generator, transformer and switch on the entire system. On the same board the potential and phase displacement at all the substations is indicated, so that the dispatcher can arrange the load demand in the most economical manner. The author predicts that within less than ten years this station will be tied in with the remaining three German main power centers by a new 220-kv. line to form one large network.—*Zeitschrift des Vereines Deutscher Ingenieure*, May 2, 1925.

Relation Between the Dimensions of a Transformer and Its Output.—F. J. TEAGO.—The author states at the beginning of this paper that it is intended to illustrate a method of design rather than to obtain a design itself. The method rests on two main factors: (1) Whereas loss not only involves fuel consumption at periods of light load but involves plant capacity as well on peak loads, it probably pays to design a transformer to have its maximum efficiency about full load; (2) it is desirable to give some definite value to x in the relationship

$$\frac{\text{total cost assembled copper}}{\text{total cost assembled iron}} = x$$

The treatment is analytical, with illustrative charts, taking into account the several weights, volumes, unit costs and other variab'es that need to be considered.—*World Power*, May, 1925.

Units, Measurements and Instruments

Kilovolt-Ampere Meters.—G. W. STUBBINGS.—This paper reviews methods of metering to give a continuous integration of kilovolt-ampere-hours, taking only those which have been in use for sufficient time to prove of practical value. In the main the treatment is confined to the compensated induction meter and the shaded-pole meter, followed by a brief graphical and analytical comparison of the indications of each with the true value.—*World Power*, May, 1925.

Loss-Angle and Capacity of Porcelain Insulators.—K. DRAEGER.—Based upon theoretical derivations and practical measurements, the author gives in this paper tabulations and curves of loss angles, loss resistance and capacity of various types of standard high-voltage chain-type insulators. For the

measurement a high-tension bridge method with a vibration-type galvanometer was used. The relation is studied between loss-angle and puncture voltage under oil and with impulse direct current. Data are also given showing how loss angle and capacity vary with temperature between 10 deg. and 120 deg. C. and with frequencies from 30 cycles to 50 cycles. In addition to this the influences of voltage, time and mechanical stress are investigated. — *Elektrotechnische Zeitschrift*, May 7, 1925.

Illumination

Records of Daylight by the Photo-electric Cell. — JAMES E. IVES. — This paper contains a description of the photo-electric cell and recorder now in use by the Office of Industrial Hygiene and Sanitation of the United States Public Health Service for obtaining a continuous record of total daylight illumination on a horizontal plane, out of doors, in Washington, D. C. The instruments used and the records obtained are described and discussed. The cell, based upon a discovery by T. W. Case, is made of hard glass in the form of a cylindrical bulb about 2 in. in diameter and 5½ in. long. The negative electrode consists of a film of aluminum deposited on the inner surface of the bulb in the form of a rectangular plate. The positive consists of a loop of twisted platinum ribbon in the axis of the bulb. The photo-active material is an extremely thin coating deposited by heating an oxide of barium previously placed on the ribbon. The temperature effect is small, but the sensitivity curve of the cell differs materially from that of the eye. This is compensated by the use of a light filter of brownish-yellow glass. Above saturation, which occurs when the applied voltage has been raised to about 200 volts, the photo-electric current is stated to be directly proportional to the incident light. To secure a permanent record a recording potentiometer is connected in series with the cell.—*Transactions of I. E. S.*, May, 1925.

Motors and Control

Use of Polyphase Frequency Changers for Phase Compensation of Three-Phase Induction Motors.—L. DREYFUS. —The author gives the theory for phase compensation of large induction motors by the use of a special "frequency changer" rotating in synchronism with the main motor. This frequency changer is arranged as a synchronous converter, connected to the line through a transformer, with the commutator brushes connected to the collector rings of the wound secondary of the main motor. Therefore the voltage impressed upon this secondary alternates with the slip frequency, while its magnitude and phase relation can be varied at will, thus giving a convenient method of varying the phase displacement and speed of the main motor. The main purpose of this article is to give a theoretical explanation of the performance of this arrangement for low values of the slip. It is shown that the ordinary circle diagram for the three-phase induction motor can be modified to give complete information for the compensated arrangement.—*Teknisk Tidskrift* (*Swedish*), *Elektroteknik*, May 2, 1925.

Electrophysics, Electrochemistry and Batteries

Effect of Superposed Alternating Field on Apparent Magnetic Permeability and Hysteresis Loss.—T. SPOONER.—It is shown that, contrary to the assumption of increased permeability and decreased hysteresis loss when alternating and constant magnetizing forces are superposed, these effects are only apparent and that the true permeability and hysteresis remain practically the same as under constant field conditions. What are actually measured are the midpoints of displaced minor loops. From the known laws of variation of these minor loops the apparent magnetization curves and hysteresis loops under a superposed alternating field can be calculated. The method of doing this is illustrated. Under these assumptions a superposed alternating field actually increases the hysteresis loss, the latter including losses due to displaced minor loops besides those due to an increased major loop. The conclusions are supported by magnetization curves obtained with 1 per cent silicon steel punchings.—*Physical Review*, April, 1925.

Tacoma Copper Smelter and Refinery.—GEORGE J. YOUNG.—The article includes data on an electrolytic refining plant having an aggregate capacity, in three tank houses, of 8,500 tons of copper per month, with 1,186 tanks, and generators having a combined rating of 28,000 amp. at 150 volts to 185 volts. —*Engineering and Mining Journal-Press*, April 4, 1925.

Motion of Electricity in Metals.—A report of a lecture before the Institute of Metals by Prof. H. A. Lorentz in which he reviewed modern ideas on the above-named subject, taking into account the number of atoms in a cubic centimeter of metal, the number and charge of the electrons and other results of recent research, and, among other things, arrived at certain quantitative values for the flow of the electrons and the associated energy. The report lets it be inferred that the lecture was highly mathematical.—*Electrician* (*England*), May 15, 1925.

Traction

Overhead Construction of Electrified Austrian Railways.—H. LUITHLEN.—Complete construction data are given in this paper on the newly finished electrified sections of the Austrian federal railroads, particularly the two main lines—the Innsbruck-West Alberg tunnel and the Salzkammergut section. They are single-phase, 15-kv., 16⅔-cycle systems with single-phase feeders of 55 kv. Three Austrian firms participated in the installation, each furnishing and installing its own system on a given section. While the general methods of these three firms are substantially alike, the differences in their individual methods of construction are sufficient to upset the uniformity of the line. The great difficulties encountered carrying the feeders across very high mountains, with eternal snow and ice, and in suspending 15,000-volt catenaries in a permanently wet tunnel 7 miles long are described.—*Elektrotechnik und Maschinenbau*, May 10, 1925.

Rail Welding.—Welding practice on various street-railway lines is described in the report of a symposium at the annual meeting of the American Welding Society in New York.—*Electric Railway Journal*, May 2, 1925.

Telegraphy, Telephony, Radio and Signals

Radio-Frequency Measurements. — E. B. MOULLIN. — Available types of instruments are discussed and a résumé is given of the principles of resonance circuit measurements, with suggestions for avoiding the effects of stray capacitances. Circuit diagrams are shown. —*World Power*, May, 1925.

Electronic Valves and Some of Their Applications.—A. A. TCHERNYSHEV.—The author describes the use of electronic valves, their importance in science and engineering, and gives a short description of an apparatus for "television" being worked out at the present time under his direction in one of the state physical laboratories. — *Elektrichestwo*, No. 4.

Design of Non-Distorting Power Amplifiers.—E. W. KELLOGG.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the mid-winter convention, February 21, 1925, on page 393.—*Journal of A. I. E. E.*, May, 1925.

Miscellaneous

World Market for Electrical Goods. —HUGH QUIGLEY.—In this study of the competitive position of Britain in the international market the author has assembled and compared an impressive mass of statistics, which can, of course, be used equally well to show the competitive position of his country's rivals. The producing countries compared are Britain, the United States, Germany, France, Switzerland, Austria, Sweden, Italy and Holland. A table gives the value of their output of electrical machinery and of machinery plus apparatus for 1923. In the latter item the first three countries were substantially on a par; in machinery alone Germany was in the lead, with 32 per cent of the world's exports, followed by the United States and England. For the five leaders the shift since 1913 is then shown. It is pointed out that Britain's chief competitor, formerly Germany, is now the United States. Next are analyzed the imports to the British colonies, first as to their origin, then as to their growth, as between Britain and the United States, since 1908. A similar table is given for other importing countries. Finally British and German exports to every civilized country on the globe for 1913 and 1923 are set side by side. Britain is now decisively outdistanced by the United States in Canada, Japan, China, Brazil and Chile and has lost ground in Australia, South Africa and Argentina. The European market is predominantly German. Some of these statistics are summed up in an insert chart.—*World Power*, May, 1925.

News of the Industry

Santa Barbara Lines Stand

Little Damage Done by Earthquake to Edison System There—Quick Resumption of Service

DAMAGE to the properties of the Southern California Edison Company by the disastrous earthquake at Santa Barbara early Monday morning was not large and was confined almost entirely to distribution lines and equipment. The total loss is put at less than $15,000. The fact that most of the substation equipment is of the out-of-door type kept the damage to a minimum, and the company will be able to restore service to the city as soon as the city is ready for it. Fearing that fires would be caused by short circuits, the city has passed an ordinance prohibiting the use of electricity in homes until all residences can be inspected.

Immediately on receipt of news of the earthquake the Southern California Edison Company dispatched a fleet of trucks with a crew of a hundred men to Santa Barbara, and within twelve hours of the first shock street lamps were in operation in State Street. Restoration on other streets is following quickly. The trolley lines on many thoroughfares were fastened to buildings and are therefore down. Buses are being operated while repairs are made.

NO HARM WROUGHT IN MONTANA

The Montana Power Company, which has hydro-electric generating plants near Great Falls and transmission lines serving other places reported to have been in the region affected by the recent small earthquakes in Montana, informs the ELECTRICAL WORLD that any harm inflicted upon its system is of a trifling nature. A few poles overthrown, the company says, about sums up the damage.

Fitkin Interests Buy Virginia and Other Properties

The National Public Service Corporation, organized by the A. E. Fitkin interests of New York, has acquired the Virginia Western Power Company, which, with headquarters in Clifton Forge, Va., serves fifteen communities in Virginia and West Virginia with electric power and light. There are possibilities for a connection with other of the corporation's Virginia properties, particularly at Alexandria.

The Virginia Western Company owns and operates four steam and three hydro-electric generating plants serving 14,000 customers in Charlottesville, Waynesboro, Staunton, Lexington, Glasgow, Buena Vista, Buchanan, Eagle Rock, Clifton Forge and Covington in Virginia. Communities served in West Virginia are White Sulphur Springs, Lewisburg, Ronceverte, Alderson and Hinton. With the completion of 110,000-volt steel-tower transmission lines now under construction between plants it will be possible to shut down all these West Virginia plants except the one at Ronceverte. The National Public Service Corporation has also under option several hydro-electric sites which will be developed as additional facilities are demanded in the territory.

To the Jersey Central Power & Light Company, another Fitkin holding company, permission has been granted by the New Jersey Board of Public Utility Commissioners to take over the Millburn (N. J.) Electric Company, which will be added to the system embracing the properties at Morristown, Long Branch, Lakewood, Toms River and Pompton Lakes, N. J.

Insull Interests Seek Manchester (N. H.) Utility

As previously intimated in the ELECTRICAL WORLD, negotiations are in progress between the Middle West Utilities Company and the stockholders of the Manchester (N. H.) Traction, Light & Power Company for the sale of the latter property to the former. At this writing it is expected that the transfer will go through without delay. An offer has been made by Martin J. Insull, president of the Middle West company, of $150 per share for all the outstanding stock of the Manchester company, provided that at least 55 per cent is acquired at this price by July 15. Stockholders of record will receive the regular quarterly dividend of 2 per cent whether their stock has been deposited or not. The directors of the Manchester company have unanimously recommended acceptance of the Insull offer.

The Manchester property is one of the best-known central-station and traction companies in New England. It serves an important section of southern New Hampshire, including the city of Nashua, and its total operating revenue in 1924 was $2,511,501, of which $1,544,316 was from the sale of electric light and power and $739,373 from the railway division. Steam and hydro-electric plants are operated on the Merrimac River and tributary streams, and the total assets on December 31 were $13,186,685, the fixed assets being about $11,749,000. The system is interconnected with the Concord (N. H.) Electric Company and through Nashua with the 66,000-volt lines of the New England Power Company.

Note was recently made in these columns of the purchase by the Insull interests of the Vermont Hydro-Electric Corporation of Rutland, Vt., and of negotiations for the acquisition of the Central Maine Power Company by this group. If these various transfers are consummated, according to present indications the way will be open for important engineering, operating and commercial developments.

No Rush for Shoals Power

Only Two Replies to Letter of Chief of Engineers—Southern Companies Alone Interested

ALTHOUGH the letter printed last week (page 1415) from General Harry Taylor, Chief of Engineers, U. S. A., which invited bids for power to be produced during the testing period of the Muscle Shoals plant—the sale of this power being hedged about with restrictions—was sent to a number of companies and individuals presumably interested, only two replies were received, and of these only one evinced a desire to utilize the power. The Union Carbide Company replied that it would not be interested in the purchase of power under conditions outlined. The other reply was from the Alabama Power Company on behalf of the associated Southern companies which desire to use the power.

General Taylor's letter was sent to Henry Ford, Detroit; General W. W. Atterbury, Philadelphia; the Union Carbide Company, New York; the Memphis Power & Light Company, Memphis; the Southern Power Company, New York; the Georgia Railway & Power Company, Atlanta; the Electric Bond & Share Company, New York; the American Cyanamid Company, New York; the Tennessee Electric Power Company, Chattanooga; the Alabama Power Company, Birmingham, and H. C. Couch, Pine Bluff, Ark.

Hetch Hetchy Contract in Hands of Secretary Work

Final passage of an ordinance authorizing the Board of Public Works of San Francisco to enter into a contract with the Pacific Gas & Electric Company for temporary distribution of Hetch Hetchy power came before the Board of Supervisors on June 29 and was carried by a vote of eleven to seven.

The proposed contract is now in the hands of the Secretary of the Interior at Washington for his opinion as to its legality within the terms of the Raker act, under which San Francisco was granted certain water rights from the federal government. If no legal obstacles turn up, the way is now paved for San Francisco to realize $2,000,000 a year from the output of its 70,000-kw. municipal power plant until such time as the people of the city decide upon the question of municipal distribution.

The Modesto Irrigation District has filed a protest with the city and the Secretary of the Interior against the sale. This action is taken on the ground that the proposed contract is a violation of the Raker act and that it does not properly provide for the needs of the irrigation district.

Those who are familiar with the

situation in San Francisco, however, claim that the irrigation district has no ground for protest because the proposed contract with the Pacific Gas & Electric Company specifically provides that the company will receive the output of the Moccasin plant diminished only by losses and city needs "and also by such amounts, if any, as the city may be legally required to furnish to irrigation districts or municipalities under the Raker act."

Long Delay for Conowingo Indicated

Pennsylvania Commission Evinces Dissatisfaction with Financial Plans—Revised Engineering Details Defended by Kellogg and Eglin

IT WAS made clear in Philadelphia on Friday, June 26, at the resumed inquiry by the Pennsylvania Public Service Commission into the projected interstate hydro-electric plant at Conowingo, Md., that the commission was dissatisfied with the intercorporate relations and bonding plans of the companies concerned and not yet convinced of the financial feasibility of the project. Official approval is not likely to come in Pennsylvania until the financial "set-up" has been altered and detailed plans for marketing the bonds to be put behind the fifty-two-million-dollar undertaking have been spread before the commission. As the Maryland Public Service Commission and the Federal Power Commission must also extend approval before the work can begin, it seems unlikely that the dam will get under way this year.

James S. Benn acted as chairman of the hearing in the absence of W. D. B. Ainey. Three Maryland commissioners and Secretary Merrill of the Federal Power Commission participated in the hearing, which was finally adjourned until July 15, when it is thought that testimony from the Philadelphia Electric Company and from the chief opponent of the project, the Philadelphia Rapid Transit Company, will be concluded.

ENGINEERING CHANGES

The changes in engineering details were explained by Charles W. Kellogg of Stone & Webster, contractors for the plant. Mr. Kellogg insisted that the Philadelphia Electric Company would be enabled to save $779,000 a year through the substitution of hydro-electricity for steam power, even with a reduction from 103 ft., as previously planned for the dam height, to 86 ft., with superimposed steel gates raising the water level up to 108½ ft. Other changes outlined by Mr. Kellogg included an increase in the number of turbine units from six of 50,000 hp. each to seven of 43,000 hp. each, an increase in the generator capacity, and the designing of a new bridge resting on the dam piers to replace the State Highway bridge, which will be wiped out.

W. C. L. Eglin, chief engineer of the Philadelphia Electric Company, corroborated Mr. Kellogg's statements, which were attacked by the counsel for the Philadelphia Rapid Transit Company, who asserted that the Conowingo project would entail an annual loss of more than $900,000 to the Philadelphia company. The Philadelphia Rapid Transit Company maintains also that the whole project will cost almost twice the sum estimated.

In response to doubts expressed by the Pennsylvania commissioners concerning their power under the original corporate plans to regulate rates for Conowingo power used in that state, counsel for the Philadelphia Electric Company put forward a plan by which the two Maryland companies concerned —the Susquehanna Electric Company and the Susquehanna Power Company —would be placed under the jurisdiction of the Pennsylvania commission by changing ownership of a portion of the transmission lines in Maryland to the Susquehanna Power Company, which would lease the lines to the Susquehanna Electric Company. The two Maryland companies then doing business in Pennsylvania would be registered as foreign companies and would be subject to regulation by the Pennsylvania commission.

While the proposed plan was agreeable to the Pennsylvania commission, question was raised by the Maryland commissioners as to what effect such a change would have on plans already submitted to them.

A meeting of the Maryland Public Service Commission to take up the whole subject as it affects that state will be called after the hearings before the Pennsylvania Public Service Commission have been completed.

Construction Soon to Start on Feather River Plant

Signing of a contract for the sale of the output of the Bald Rock power plant of the Feather River Power Company to the Great Western Power Company assures the early construction of a 60,000-hp. hydro-electric plant in northern California. The plant will be the first of six in a development which will produce 400,000 hp., costing between $45,000,000 and $50,000,000 (see ELECTRICAL WORLD for April 18, page 833).

The plant now to be constructed will be at Buck's Creek on the Middle Fork of the Feather River, a short distance above the Las Plumas plant of the Great Western Power Company. It will contain two units operating under a head of 2,580 ft. A dam across the Feather River will create a storage reservoir of 110,000 acre-feet capacity. The Great Western Power Company will take delivery at the power house on the high side of the transformers. Transmission will be at 220 kv.

The Feather River Power Company is now waiting for release of its permit by the Federal Power Commission, following which construction work on the plant will begin.

Business and Pleasure Meet

Convention of Michigan Electric Light Association at Mackinac Island Combines Them Well

MACKINAC ISLAND, Mich., a famous pleasure resort of the Middle West, was the scene of the annual convention of the Michigan Electric Light Association on June 25-27, and the program that had been arranged combined business and pleasure in a happy manner.

An event of importance was the special session given to the consideration of the women's work in the utilities of the state. Evidence of the interest taken in this movement was found in the attendance of 118 women. Miss Thelma Tinkham, state chairman of the women's committee, urged that the training of women in utility problems begin at fundamentals. Miss Estelle French, Commonwealth Power Corporation, emphasized the importance of teaching the women the meaning of technical terms by using, if possible, "twopenny words which seem to have been dropped from the vocabulary of technical men." Miss French told of experience with a weekly bulletin issued to the women to give them information of value and to serve as a "question box" on subjects little understood by them. "Better informed women mean a better informed public," said Miss French. Miss Marguerite Shelline, Michigan Gas & Electric Company, and Miss G. Edwards, Detroit Edison Company, told of work done in their companies by and for the women, and Miss Margaret Hartnacke, Consumers Power Company, related experiences of those engaged in the company's department of personal service.

Donald M. Mackie, Consumers Power Company, alluding to the award of the Charles A. Coffin medal to this company, spoke of the part advertising played in the record made and in the general improvement of utility morale and public esteem.

The importance of convincing the farmer of the value of power equipment was stressed by reports on 459 farms that were using electricity for lighting but not for power. The average bill of these farms is only $1.79 per month, and only 16 hp. in motors were found among this entire group of farms.

How a utility can maintain sound credit conditions in a community that is dependent upon one industry, and that industry in a most unhealthy condition, was told by W. H. Burke, Houghton County Electric Light Company. Mr. Burke urged more consideration for the economic condition of such customers and that they be offered somewhat more liberal credit terms than is customary. Promotion of better lighting among the smaller communities was discussed by J. F. Mayor, Consumers Power Company.

Alfred Fischer, director Michigan Committee on Public Utility Information, said that the requests for speakers to appear before civic organizations showed little interest in a discussion of municipal ownership but a great interest in the electrification of the home, better lighting methods, merchandising policies and methods of

utilizing electric service most effectively. Publicity, Mr. Fischer said, "has done its part to make curios of the coal scuttle and lamp chimney and will some day add to that collection the ash barrel and the ice pick, the broom and the dish towel."

Mr. Fisher spoke at the banquet, which was presided over by A. C. Marshall, vice-president Detroit Edison Company. A. W. Stace, editor Grand Rapids *Press*, made an address on Michigan.

Officers elected by the convention were: President, F. D. Avis, secretary and general manager Southern Michigan Light & Power Company, Hudson; first vice-president, Paul B. Simons, vice-president and general manager Michigan Gas & Electric Company, Three Rivers; second vice-president, D. E. Byerley, manager Citizens' Light & Power Company, Adrian; secretary-treasurer, Herbert Silvester, Detroit Edison Company, Ann Arbor.

Good Program Ready for First East Central Convention

Seven sessions loaded with excellent papers, reports, addresses and discussions are scheduled for the first annual convention of the East Central Division of the National Electric Light Association, to be held at Cedar Point, Ohio, on July 14 to 17. This convention is the first since the merger of the Ohio Electric Light Association with the N. E. L. A., and it will carry on the activities of the old Ohio association, with the participation of Kentucky and West Virginia and the co-ordination of the national organization. The main features of the program follow:

TUESDAY, JULY 14

Morning.—President's address, T. O. Kennedy; greeting, J. E. Davidson, president N. E. L. A.; "Plans of N. E. L. A.," M. H. Aylesworth; "Inductive Co-ordination," Prof. A. M. Wilson.

Afternoon.—Review of Technical Section work, O. H. Hutchings; report of power production committee, L. E. Brown; "Status of Electrical Apparatus Development," William Shuler; "Development of the Modern Power Station," C. F. Hirshfeld.

WEDNESDAY, JULY 15

Morning.—"Commercial Section Activities," S. D. Heed; report of lighting committee, J. P. Campbell; five-minute talks on local achievements by E. L. Canfield of Canton, H. W. Derry of Cincinnati, L. W. McLellen of Louisville, C. L. Dunn of Cleveland and K. Fitzpatrick of Dayton; "The National Industrial Lighting Campaign," H. W. Derry; report of power committee, H. N. Wood; electric transportation, B. J. Martin; appliance sales, J. B. Wilson and T. L. Phillips; domestic refrigeration, G. E. Miller.

Afternoon.—Report of meter committee, Karl H. Bausman; "Meter Department Economics," R. C. Fryer; "Instrument Transformers," J. N. Swartz (discussion by E. E. Kline and J. R. Halladay); "Value of a Superpower Survey," H. H. Field (Great Lakes Division) "Power Survey for the East Central Division," L. S. Streng; "Relations with Financial Institutions," H. A. Fountain.

THURSDAY, JULY 16

Morning.—"Public Relations of a Utility the Key to Its Success," L. B. Herrington; "Customer Ownership," P. H. Whiting; "General and Special Publicity," Benjamin E. Ling and Frank Ryan; "Co-operation with Educational Institutions," Col. Dudley J. Hard; report of women's public information committee, Mrs. F. A. Tate and Miss Helen Steiner.

Afternoon.—Report of overhead-underground systems committee, G. M. Miller; "Installation and Operation of 66-Kv. Lead-Covered Cable," D. C. Ober; "Testing of Insulators on Live Lines," D. W. Nethercut; "Load Dispatching and Allocation of Load on Interconnected Transmission Systems," Mr. Williams; "The Matter of Safety," H. E. Hoadley.

FRIDAY, JULY 17

Morning.—"Mechanical Methods of Consumers' Accounting Without Ledgers—The Telautograph," B. C. Taylor; report of rural electrification committee, J. B. Johnson; "Work of the National Committee on Relation of Electricity to Agriculture," Dr. E. A. White; "East Central Division Survey of the Committee on Relation of Electricity to Agriculture," B. P. Hess.

Applications Before Federal Power Commission

The Feather River Power Company has applied to the Federal Power Commission for a license covering a 60,000-hp. project in Plumas County, Cal. This project involves the water resources of Buck, Grizzly and Milk Creeks, tributaries of the North Fork of the Feather River. The plan is to erect a concrete arch dam 106 ft. in height in Buck Creek. This will create a reservoir with a capacity of 103,000 acre-feet. Conduits will connect Milk Creek with the reservoir. The power house will be on the east bank of the North Fork, one-fourth mile below Buck Creek. The water from Grizzly Creek will be brought by conduit.

The Kentucky-Tennessee Light & Power Company has applied for a preliminary permit covering a further project on Green River, Kentucky. The proposal is to construct a power house at each of the existing United States dams No. 2 and No. 3. It is the intention to install equipment capable of generating 6,000 hp.

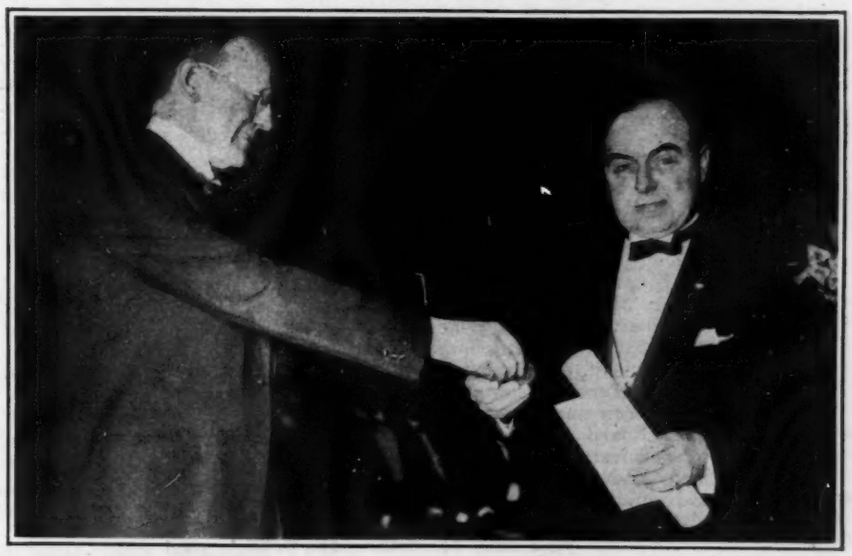
A preliminary permit is desired by C. A. Giffen, P. W. Porter and associates of Los Angeles for a power development on the North Fork of Trinity River, Trinity County, Cal. The installation will consist of a dam 200 ft. high on each of two branches of the North Fork and will develop a primary capacity of 15,000 hp.

The Inland Power & Light Company has applied to the commission for a preliminary permit covering a project on the Clearwater River in Nez Perce County, near Lewiston, Idaho. The dam is to be built two miles above Lewiston and the power house is to be on Clearwater Slough. This application conflicts with an application of the city of Lewiston filed December 17, 1924.

Federal Power Commission and Barge Canal Diversion

Neither Representative Dempsey of Lockport, N. Y., nor the mill owners on Eighteen-Mile Creek are willing to accept as final the decision of the Federal Power Commission in the case of the Hydraulic Race Company and others limiting their use of water from the Niagara River to 275 cu.ft. per second. They want 500 sec.-ft. and think the preliminary permit committed the commission to that amount. The commission takes the position that the mention of 500 sec.-ft. clearly was a maximum not to be exceeded. The license which will be issued will provide, however, for a swing of 20 per cent, but neither the average use nor that maximum must be exceeded. It is held that 1,550 sec.-ft. is the maximum amount which can be handled through the Barge Canal without setting up currents so swift as to interfere with navigation. The license will make it plain that no obligation upon the state to continue to transport the water is imposed or implied. The federal license will expire in fifty years or when the state rights are canceled.

Consumers Power Company Gets Coffin Medal



AS STATED in the Convention Report Issue of the ELECTRICAL WORLD, printed June 20, the Charles A. Coffin medal and award to the central-station company which during the year had made the greatest contribution to the development of the use of electric light and power went to the Consumers Power Company, which serves a great territory in Michigan, with headquarters at Jackson. In the photograph Franklin T. Griffith, president of the National Electric Light Association, is seen handing the medal to vice-president T. A. Kenney of the Consumers Power Company.

Ohio's Million Consumers

Eleven Big Companies and 211 Smaller Ones Produced 3,473,000,000 Kw.-Hr. Last Year

OHIO has about one million consumers of electricity furnished by central generating stations, according to a compilation just made by the Ohio Public Utilities Commission from annual reports of the 222 companies in the state. This compilation shows that on the first of this year there were 990,831 homes, commercial establishments and industrial plants using electric light and power. This was an increase of 95,519 over the year before, or a monthly increase of 7,060 consumers. On the same basis of increase the number of consumers on the first of June would be around 1,030,631 in Ohio.

To meet this demand for increased electrical service, it was necessary to increase the investment in these companies by $44,865,056 during the year, bringing the total investment up to $360,508,700. At the same time, these annual reports show operating expenses increased by $441,926, to $48,036,018, and taxes were increased by $287,751. The total amount of taxes paid during the year by these companies was $8,021,735. A compilation of the reports shows a total of 3,473,778,818 kw.-hr. distributed during the year. This was an increase of 150,211,938 kw.-hr. over the year before.

Although there are 222 companies now reporting to the Public Utilities Commission, eleven of them serve more than 80 per cent of the total users. On January 1 of this year these companies reported the number of their consumers as follows:

Cleveland Electric Illuminating Company	233,055
Union Gas & Electric Company	107,423
Ohio Power Company	93,190
Toledo Edison Company	75,285
Dayton Power & Light Company	66,609
Columbus Railway, Power & Light Company	65,712
Ohio Public Service Company	59,878
Northern Ohio Traction & Light Company	50,745
Pennsylvania-Ohio Electric Light Company	38,222
Ohio Edison Company	19,395
Ohio Service Company	17,508

St. Lawrence Development Up Again at Ottawa

The question of power development on the St. Lawrence River was debated at considerable length in the Canadian Parliament on June 24. George P. Graham, Minister of Railways and Canals, in accordance with the advice of the International Joint Commission, opposed the development of power on the St. Lawrence before a thorough investigation had been made by the Joint Engineering Board now working on the St. Lawrence waterway scheme. Arthur Meighen, leader of the Conservative opposition, urged that the Hydro-Electric Power Commission of Ontario was the best equipped body to give an opinion as to how the matter of power development should be handled. Sir Henry Drayton, former Minister of Finance, said that it was three years since the Hydro commission had made its application for power development at Morrisburg. He thought action should be taken immediately.

At a banquet at Niagara Falls, Ontario, under the joint auspices of the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities, a letter was read from Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission, in which he urged the closest scrutiny of every proposal to develop Ontario's remaining water-power resources and deplored the delay in developing power on the upper St. Lawrence. "During the past year," the letter read, "the number of municipalities under contract has increased from 356 to 386. The amount of power generated reached in December, 1924, an aggregate of 780,000 hp. During the year the capital investment in our municipal undertaking increased from $242,000,000 to about $263,000,000. The annual revenue now amounts to nearly $19,000,000, and the reserves set aside for renewals and sinking fund by the commission and the municipalities now amount to over $39,000,000."

Human Relations First

Personal Service, Rural Load and Sales Methods Also Discussed by Empire State Commercial Men

HUMAN representation of utility companies to their customers through the medium of conscientious, well-trained employees is the uppermost problem before the central-station industry today, declared Chairman W. J. Reagan at a two-day meeting of the Empire State Gas and Electric Association's Commercial Section held at the Hotel Van Curler, Schenectady, N. Y., on June 25 and 26. The task of accomplishing closer contact with the public, Mr. Reagan pointed out, devolves largely upon the commercial departments of electric power and light companies, and with the expansion of these departments, embracing the additional home service work which many companies are inaugurating, much prejudice against utilities and their service is being overcome. Greater attention on the part of executives to the operation of utility commercial departments Mr. Reagan interpreted as an indication of the growing importance of this branch of the industry to its ultimate welfare.

Col. Oscar H. Fogg, vice-president of the Consolidated Gas Company of New York, in an address on "Commercial Departments and Public Relations" emphasized the fact that the public has a right not only to demand that it receive good service but that it be rendered in a human and friendly manner. "There are few utilities," he said, "that are not making a sincere effort to develop good public relations, and we must try to perfect ways and means of maintaining the public's good will." Colonel Fogg warned particularly against tactless methods in handling delinquent accounts and pointed out the danger of too rigid routine methods, which, while effective and efficient in themselves, might cost a company many thousands of dollars by engendering antagonism in the minds of customers. People will condone physical defects or failure of service, but they will not forgive or forget discourtesy or failure of the human element.

Efforts of lamp manufacturers to simplify and standardize the size and number of styles of incandescent lamps were explained by O. B. Anderson, commercial engineer of the Edison Lamp Works. It is hoped through the lamp simplification program to effect further price reductions, and Mr. Anderson urged that central-station men lend their assistance by suggestions and criticism based on their actual experience in contact with customers.

"Advertising" as affecting the central-station company's public relations and sales was the subject of an address by Stevenson H. Evans, who deprecated the attempt by some utilities to accomplish definite results by spasmodic or intermittent publicity programs. Consistent and continuous advertising only will bring results.

The second day was devoted to discussions of rural load development, home service work and central-station sales methods.

Utilities have an obligation to develop electric service for the farm because the average farm is both a home and an industry, declared Charles H. Churchill, Jr., of the Adirondack Power & Light Corporation in a paper on "Developing the Farm Load." Present-day farms, he pointed out, require lighting and water systems for the house, domestic labor-saving devices of all kinds, and with farm labor so difficult to obtain even the smaller farms will find electrical machinery of value. With improved roads and transportation the exodus from urban centers will continue, so that the net result will doubtless be more rather than fewer homes in farm territory, thus making for a much-desired increase in customer density for this class of electric service. Following Mr. Churchill's paper a motion picture, "The Farm Electric," was shown.

Mrs. Pauline L. Rohrs, Associated Gas & Electric Companies, in a paper on "Home Service," described the work being done by specially trained women in demonstrating the correct use of household appliances in the home and through classes in cooking conducted by various utility companies. The women of the household have the chief contact with the central-station companies, and she made clear the value of this work in promoting public relations which often prove to be worth far more than the increased sales of energy.

In a paper on "Salesmanship" Fred H. Kimball, manager of the small-motors department, General Electric Company, discussed methods of training and handling salesmen and pointed out the common interest of the utilities and electrical manufacturer in effecting improvements in central-station commercial methods.

At the close of the meeting R. V. Howes of the Consolidated Gas Company was unanimously elected chairman to succeed W. J. Reagan, and E. L. Wilder of the Rochester Gas & Electric Corporation was elected vice-chairman, also unanimously.

Merrill on Muscle Shoals

For Widest Sale of Power at Lowest Cost Compatible with Nitrate Production and Reimbursing

IN RESPONSE to an inquiry from the President's Muscle Shoals Commission, O. C. Merrill, the executive secretary of the Federal Power Commission, has submitted suggestions for the disposition of the government's properties which are summarized as follows:

1. The properties of the United States at Muscle Shoals useful in the production of power and those useful in the manufacture of nitrates to be segregated from each other and from the remaining properties, each group to be subject to separate disposition.

2. The nitrate properties to be sold or leased, whichever procedure may make possible the best terms and surest guarantees for nitrate production by private capital. If such guarantees cannot be had, then the United States itself to operate the properties.

3. Adequate reservations of power for nitrate operations at cost of production in hydro plant.

4. All surplus energy above requirements for nitrate production to be disposed of in the general public service.

5. The hydro properties to be leased under the terms of the federal water-power act, subject to a reservation of power for nitrate operations and to specific conditions guaranteeing distribution of surplus power throughout the South at rates which shall fully reflect the cost of production at Muscle Shoals.

6. The steam plant to go with the hydro plant, either in the same lease or by sale to lessee.

7. Lease of power properties to be to a corporation jointly financed and owned by the several utility companies interconnected in the Southern transmission network.

8. Lessee of power properties to pay an annual rental sufficient to discharge current obligations and to retire capital invested in not less than fifty years.

FOUR OBJECTS SOUGHT

The chief objects to be sought in the operation of the power properties, in Mr. Merrill's opinion, follow in the order of their importance:

1. Development of sufficient low-cost power to serve the needs of nitrate production at Muscle Shoals.

2. Reimbursement of all costs of operation and of all fixed charges upon the properties.

3. Retirement of the capital investment of the United States in the power properties.

4. Widest practicable distribution and sale of power at the lowest cost consistent with the three preceding conditions.

The first three conditions can be fulfilled whether the plants are operated by the government or are leased for operation. It is very doubtful, Mr. Merrill says, whether government operation would be as well suited as private operation to accomplish the fourth. Operation by the government would be merely wholesaling of power at substations to whomever might be in a position to purchase. With the sale the transaction ends. There is no authority to go beyond the sale and regulate the price at which the power is resold or the services to be rendered by the purchaser from the government. The government itself cannot go into the distribution of power without the construction of hundreds of miles of transmission lines, the expenditure of many additional millions of dollars and the creation of a big organization to handle a business one-third as large as that of all the existing utility companies in the South. Furthermore, to make the surplus power available for general use throughout the Southern transmission network and to get the best results from interconnection, the plants at Muscle Shoals must be operated in synchronism with other plants in the network and be so controlled as to adapt their operations to those of the other plants. This cannot be successfully accomplished without unified operation.

Meets Radical in Debate

Vice-President Williams of New York Edison Discusses Public Ownership with Hillquit

BEFORE a conference on public versus private ownership of public utilities conducted by the League for Industrial Democracy which was held at Bushkill, Pa., last Saturday, June 27, Arthur Williams, vice-president New York Edison Company in charge of public relations, met Morris Hillquit, well-known leader in the Socialist party, in debate.

Mr. Hillquit asserted that public utilities are by their very nature quasi-public institutions and that their business is a public function. He declared that the first and most cardinal distinction between the two systems is that private ownership and management is undertaken and conducted primarily for private profits, while public ownership and operation are primarily instituted for the public good.

Mr. Williams declared that government ownership is not an upward step in economic evolution and gave instances from recent European history to sustain his belief. He also adduced the federal government's attempt at operating the railroads, with its attendant waste, depreciation and high cost, as an object lesson and presented a mass of evidence indicating that privately owned electric service companies in the United States have accomplished as much as, and more than, the much discussed government-owned Ontario system.

In closing his address Mr. Williams said: "The avowed purpose of the proponents of public ownership is to improve the economic position of the wage earners of the country. To this no one can take exception—it should have the support of every one as a fundamental principle of our industrial and economic life.

"Under conditions as we find them I urge that instead of organizing and sustaining a condition of social warfare, we seek to promote the necessary and desirable human objectives through present social and industrial agencies rather than by new and untried methods. With so much accomplished and in the course of accomplishment in the interest not only of our workers but of our entire citizenship, why not, through common co-ordinated effort, seek to establish a social order characterized by less apprehension and a larger measure of enjoyment of the things modern life offers to all of us?"

Details of Hurley's Gift

Why He Offered $10,000 to Company Making "Most Constructive Contribution" to Merchandising

EDWARD N. HURLEY'S offer to the Commercial Section of the National Electric Light Association to provide a prize of $10,000 to be awarded to the electric light and power company making in the ensuing year the best contribution toward the development of a more effective method of selling household appliances—an offer made public at the N. E. L. A. convention in San Francisco—was explained by him in detail in a letter to Chairman W. R. Putnam of the section under date of San Francisco, June 17. This letter follows:

I am addressing you as chairman of the Commercial Section of the National Electric Light Association because I feel that the suggestion I have to make is of particular interest and concern to the commercial branch of the electric light and power industry. For some time I have had in contemplation making available to the industries of America a fund to be applied to stimulate improvement in the methods of distributing merchandise. Facts presented before this convention would seem to indicate that the electric light and power industry today represents approximately 10 per cent of the total merchandising activity of the United States. With this as a basis for apportionment, in the program which I have in mind, I offer you the sum of $10,000 to be awarded as a prize to the electric light and power company that during the ensuing year may make the most constructive contribution toward developing a more effective method of merchandising electrical household appliances.

I have become convinced that in the more complete utilization of electrical appliances lies the solution of the most serious problem of the modern household. Domestic electric equipment now available practically makes possible the entire elimination of human labor in the home, both in the city and on the farm. It offers opportunity for saving untold hours that may be employed for the better things of life, and I believe if we can bring this fact home to the men and women of America, we shall have accomplished great good for all classes of our people.

I have no suggestion as to who shall handle this fund or how it shall be applied, except that under the auspices of the National Electric Light Association, Commercial Section, it be devoted to attracting the best thought of this branch of the industry to the working out of this very urgent and practical problem and to the development of a broader and more helpful economic service to the American home.

In accepting with appreciation the offer of Mr. Hurley and agreeing to appoint a special committee to administer his gift, the Commercial Section passed a resolution in which it said: "It is the feeling of the Commercial Section that in presenting this prize for contest it should be stipulated that it is the intent of the donor that the money be divided by the winning electric light and power company among the men and women in its employ who were responsible for the development and operation of the improved merchandising plan and methods in recognition of which the prize is given. It is believed that this will greatly inspire intelligent interest, creative thought and constructive effort in the merchandising branch."

Correlation of Rural Projects Urged

State Project Directors in Conference at Madison Take Action to Standardize Experimental Work—Many Suggestions Made to Solve Farm Problems

PROJECT directors of thirteen out of sixteen state committees organized to study the relation of electricity to agriculture met in conference at Madison, Wis., June 26 and 27, following the convention of the American Society of Agricultural Engineers, to exchange experiences, plans and problems. The states which were so represented were Alabama, California, Iowa, Minnesota, Wisconsin, Indiana, Kansas, South Dakota, Oregon, Illinois, Ohio, Virginia and Washington. Detailed reports, which may be obtained from the National Committee on Relation of Electricity to Agriculture, of which Dr. E. A. White is director, were presented giving interesting results of surveys as well as of attempts to apply electricity to different farm operations.

The reports brought out the need of further development in certain electrical applications, the adaptation of existing farm equipment to electric operation, reorganization of some farm operations and lower prices on some expensive equipment. Discussion of project problems brought up such subjects as standardization of units of measurement, records and methods of test to permit comparison of results, the problem of obtaining equipment loans for experimental use, the necessity of a clearing house for results and activities, the correlation of state projects, whether development of rate structures should be a function of the committees, when energy should be furnished gratis and the size of utility motors.

While nearly every delegate recognized the importance of rate structures and values in developing farm load, only one project leader considered it his function to study and recommend such a rate structure. It was the consensus of opinion that energy would have to be furnished gratis to farmers when they do not voluntarily adopt an application or when they are especially inconvenienced by the carrying on of tests.

Prof. L. J. Fletcher, University of California, urged correlation of state projects, but warned against asking any state to conduct investigations in which it is not interested or to discontinue investigations of interest to that state.

Scope of National Research

Closely associated with this subject was the question of whether a national investigation and research program should be developed. Prof. J. B. Davidson, Iowa State College, said research should be given a broad interpretation to include determination of what is practical, feasible and economical and to do this project leaders should submit lists of questions to which they have no answers so that these can be allocated for study through a central organization, which will find out the states best able to handle them. Prof. G. I. Christie, Purdue University, warned against making statements which will shake the confidence of the public and declared that the basis of fact finding must be standardized.

Correlation Committee Set Up

Action was taken to facilitate correlation of projects and unification of units of comparison by appointing Prof. L. J. Fletcher chairman of a correlation committee and Prof. F. D. Paine, Iowa State College, chairman of a committee on standardization of units, reports and methods of testing. The national committee will also appoint a sub-committee which will arrange for the loaning of apparatus upon each project, submitting a year's budget of equipment needed and stating the purpose for which it is to be used, when it will be needed and the amount of loaned equipment already in possession. Uniform contracts for loaning such equipment will be drawn up by this committee.

Equipment and development problems were outlined from utility, farm equipment and electrical manufacturing viewpoints by G. C. Neff, Wisconsin River Power Company, who spoke of the need for reducing the cost of service and increasing the volume of business, saying that the reductions in cost will have to come in distribution and utilization. Project leaders, he pointed out, will serve best by ascertaining how to hold down peak load and use power with as near an approach to continuous utilization as possible at good power factor.

Practical Suggestions

O. B. Zimmerman, International Harvester Company, said there is no problem in operating farm equipment from electric motors which cannot be solved and advocated reducing individual power requirements and developing long-hour use. Suggestions made concerned the development of a standard graded series of horsepower requirements for farm equipment, speed relations between motor and implement shafts, and quality, suitability and efficiency of equipment. Standard methods of rating equipment were advocated.

Rate forms and contracts for rural service were the subject of two papers by R. R. Hermann, Northern States Power Company, and E. A. Holloway, Iowa Railway & Light Company. Both went into the details of rate structures which their companies apply to rural service and favored a true fixed charge and a low energy charge which will protect the utility investment required to serve small consumers and at the same time encourage extensive use of energy.

Among other features of the conference were talks by A. J. Mason, Chicago, who gave some practical experiences with farm equipment, and Eloise Davison, Cedar Rapids, Iowa, who outlined the work of the Home Economics Bureau in connection with farm homes.

J. W. Coverdale, American Farm Bureau Federation, was re-elected chairman of the National Committee on the Relation of Electricity to Agriculture, and G. C. Neff, Wisconsin River Power Company, secretary and treasurer.

Agricultural Engineers Establish Electrical Division

As a result of the interest being shown in the relation of electricity to agriculture, the American Society of Agricultural Engineers at its convention in Madison, Wis., last week, established an electrical division, the chairman of which is yet to be announced. This action was taken because it was felt that the society as a body can undertake some work for which it is especially fitted, such as farm wiring, adapting farm equipment to electric drive and modification of farm machinery. The division will work in close harmony with the state committees already set up in many states by the National Committee on the Relation of Electricity to Agriculture.

Tenney Companies to Have New Plant at Salem

A tidewater steam generating plant of about half a million kilowatts ultimate rating is now being designed by Charles H. Tenney & Company of Boston for construction on a site at Salem, Mass., which has been under partial development for some time as a coal storage and handling terminal for the Tenney properties north of Boston. The initial installation will have a rating of about 100,000 kw. Recently the Tenney management was extended from the Malden, Revere and Salem central-station systems to include the Beverly Gas & Electric Company and the Newburyport Gas & Electric Company, and it is planned to build 130,000-volt lines from Salem to supply these newer acquisitions and also the Haverhill Electric Company, another property under this management, with energy. About 50 miles of high-tension line will be required in addition to the 60 miles of line now operated by the Eastern Massachusetts Electric Company, the transmitting organization of the North Boston Lighting Properties.

To a representative of the ELECTRICAL WORLD F. C. Sargent, vice-president in charge of engineering for the Tenney organization, said on Monday that the capacity of the present coal-storage plant at Salem can be increased from 100,000 tons to 300,000 tons as the development proceeds and that the handling plant capacity can be raised from 2,000 tons to 4,000 tons per day. Fuel for gas production can be handled through this tidewater terminal to interior points as required, and striking improvements for shipping have already been made in Salem Harbor. About 30 acres of mud flats have been reclaimed. The existing steam plant at Salem, one of the most efficient in Massachusetts, is interconnected with the Boston Edison stations, and the construction of the new Salem plant will provide a station of major size on the north of Boston, comparable in rating with the later installations on the south of the city.

Briefer News

University of Minnesota to Have Meter School.—In co-operation with the North Central Division of the National Electric Light Association, plans are being made for conducting a school for metermen at the University of Minnesota, in Minneapolis, from September 21 to 26. A course on electric vehicles will be another innovation.

Wisconsin Public Service Corporation Buys Another Hydro Plant.—Another hydro-electric power site has been added to the rapidly growing properties of the Wisconsin Public Service Corporation following the purchase at a price of $334,000 of the Peshtigo Pulp & Paper Company's dam at Portersfield on the Peshtigo River.

Interstate Public Service Buys Two Small Plants.—The Indiana Public Service Commission has issued an order authorizing the Interstate Public Service Company of Indianapolis to buy the property of the Brownstown Water & Light Company and the Jackson County Transmission Company for $162,324.

Iowa and Nebraska Affiliated Companies Move Headquarters.—The General offices of the Iowa Service Company, the Nebraska Gas & Electric Company, the Maryville Electric Light & Power Company and the Lee Electric Company, which have hitherto been in Omaha, will henceforth be established in the Gas & Electric Building in Lincoln, Neb.

Capital Invested in Canadian Water Power Multiplied by Six in Fourteen Years.—According to a report of the Water Power Branch of the Canadian Department of the Interior, the total water power developed in Canada as at February 1, 1925, was nearly 3,570,000 hp. and the capital invested therein, including transmission and distribution, was $766,758,000. In 1910 the investment stood at $121,000,000, so that the average annual increase over the fourteen years has been nearly $46,000,000.

Baltimore Engineers' Club Elects Officers.—W. W. Wyson, chief engineer of the United Railways & Electric Company, was elected president of the Engineers' Club of Baltimore at the annual meeting on June 4. W. W. Pagon, consulting engineer, was elected first vice-president; Charles C. Cook second vice-president, Hiram W. Woodward treasurer, and William J. English of the Westinghouse company was elected director-at-large.

State of Sao Paulo Takes Charge of Power Distribution as Result of Drought.—As a result of the serious power shortage which has existed in São Paulo, Brazil, for several weeks, arising from extensive drought, President Carlos de Campos recently signed a decree providing that the production and distribution of electric power in the State of São Paulo should be under the direction of the State Ministry of Agriculture, Commerce and Public Works.

Des Moines Company to Absorb Adel Plant.—It is understood that the Iowa Power & Light Company of Des Moines, a subsidiary of the Des Moines Electric Light Company, will take over the property of the Adel (Iowa) Light & Power Company, which reaches a population of about 6,000.

St. Maurice Power Company's Rights at La Gabelle Sustained.—By a unanimous decision of the Quebec Court of Appeals, the St. Maurice Power Company's rights and privileges in its developments at La Gabelle, on the St. Maurice River, Quebec, which were contested by the United Manufacturers' Company in an earlier court action, have been fully sustained. The St. Maurice Company develops 120,000 hp.

Housing Hydro Plant Operators in New England.—Housing of operators and their families at the New England Power Company's hydro-electric plant No. 5 on the Deerfield River above Hoosac Tunnel, Mass., is comfortably achieved by the community of bungalows illustrated here. While the establishment of such settlements is often a feature of hydro-electric development in remote locations, the "village" above

No. 5 is unusually well kept and challenges comparison. At the left is a right-of-way for one of the company's transmission lines which cross this territory and serve many points in central New England.

Expansion in Guadalupe District of Texas.—The Texas Central Power Company is preparing to build a transmission line from Gonzales to Cuero and to extend an existing line from Nordheim to Kenedy. In addition the company, which now serves thirteen towns in the Guadalupe district of Texas, including Cuero and Victoria, has rebuilt a dam at one of its water-power sites on the Guadalupe River near Cuero at a cost of $300,000 and is now building a power plant at Gonzales at a cost of $100,000.

Colorado Springs Power Plant Sold at Auction.—The Colorado Springs Light, Heat & Power Company was sold at auction last week to representatives of the bondholders for $655,000, the bidders being George K. Reilly and George S. Munson of Philadelphia. The sale was a legal preliminary to permit the subsequent sale of the plant to the city of Colorado Springs at the price already agreed on, —$850,000. The approval of the United States District Court is the only remaining formality.

Big Hydro-Electric Project for Durango, Mexico.—An electric power project of magnitude is being promoted by Governer Enrique R. Najera of the State of Durango, Mexico. He has interested a group of American investors in the construction of a dam across the Tunai River which will form a catchment basin for storing the flood waters that come from the rains and snows in the Sierra Madres. Engineering estimates are that more than 200,000 hp. may be generated by the proposed hydro-electric plant, from which transmission lines would be built to cities, towns and mining camps.

Mississippi River Pilot Lights May Be Changed Over to Electricity.—The Rock Island (Ill.) district of the United States Army Engineering Corps in charge of Mississippi River maintenance between St. Louis and St. Paul, has announced that it will conduct extensive experiments to determine the value of electricity for operating pilot lights along the river. Kerosene is now used, but it is thought that electricity would prove more economical and efficient.

Fix Rental for Maintenance of Submerged Weir in St. Lawrence.—The New York State Water Power Commission has fixed an annual rental charge of $10,000 and an administration charge of $1,000 to be paid by the St. Lawrence River Power Company for the maintenance of the submerged weir in the St. Lawrence River at Massena. The charge is for the use of the bed of the river upon which the weir rests and does not relate to the use of the waters of the St. Lawrence River, which was granted by the state about thirty years ago.

Penn Public Service Corporation Extends 110,000-Volt Transmission System.—The Penn Public Service Corporation, which has recently completed a 110,000-volt transmission line from its Piney hydro-electric plant on the Clarion River to Union City, Pa., and is building four new substations to serve that district in addition to one just finished at Union City, is installing new 33,000-volt circuits to Erie and Warren and will also, it is stated, begin work soon upon the extension of its 110,000-volt line from Union City to Erie.

International Association of Producers of Electrical Energy for France, Belgium and Italy.—A union of international producers of electrical energy has been formed at Paris which includes representatives of the industry from France, Belgium and Italy. The object is to compile information as to

production, distribution, finance, legislation and other matters in the countries concerned in a form available to all members. A convention will be held biannually, the first at Paris in 1926. Adhesions from other countries, possibly America, are hoped for. Georges Martz is secretary.

"Engineering Community Trust" Is Planned.—Organization of a national Engineering Community Trust, with an endowment of $20,000,000, under the headship of the Engineering Foundation and with headquarters in New York, is planned by prominent American engineers and has the approval of Alfred D. Flinn, director of the Foundation, who said: "Mr. Swasey intended his gifts for the Engineering Foundation to be but the beginning of a trust for the engineering community, which would grow to great size by many additions from engineers and other persons who are interested in, or who have profited from, engineering."

New Owners of Roanoke Rapids Power Company Find Rates Confiscatory.—The Roanoke Rapids (N. C.) Power Company has petitioned the North Carolina Corporation Commission to abrogate its contracts for electric power, which do not expire for ten or fifteen years, on the ground that the rates now in effect are confiscatory. When the contracts were made—most of them about two years ago—the company was owned by local interests. Recently it was purchased by the Virginia Railway & Power Company, which in turn has been taken over by Stone & Webster, and the new owners are applying for relief. Hearing has been set for August 31.

Ultimate Capacity of Grand Falls Plant on St. John River Put at 150,000 Hp.—The Premier of New Brunswick has announced that already the provincial government has demands for power to be developed at Grand Falls aggregating 71,000 hp. These demands are from paper-mill companies. He said the initial development at Grand Falls was to be from 50,000 hp. to 60,000 hp. and that it was proposed to develop later another 25,000 hp. and ultimately still another 75,000 hp., making the final capacity of the plant 150,000 hp. The Grand Falls Company, of which the International Paper Company is a two-thirds owner, has made a settlement with the province for $1,200,000 cash for its rights on the river. The International Paper Company will have 14,000 hp. primary and 10,000 hp. secondary horsepower reserved for its use.

Air Mail Landing Fields Lighted by 500,000,000-Cp. Floodlamps. — The United States air mail landing fields from Omaha to San Francisco are being equipped with B. B. T. dioptric 500,000,000-cp. floodlamps. The lamp is composed of a large ground-glass lens built up to twenty-one dioptric elements of circular dimensions so that it throws the light in a radius of 180 deg. The lens is contained in a heavy steel waterproof casing in which are mounted the electrical connections and mechanism for operating the light source. The light source consists of a 20,000-cp. special incandescent lamp which may be run off a 100-volt or 110-volt circuit or a standard automatic arc. The air mail landing fields between New Brunswick, N. J., and Omaha have already installed these lights, as has the field at Cheyenne, Wyo.

Rocky Mountain Division, N. E. L. A., to Increase Length of Convention.—Definite plans for the annual joint convention of the Rocky Mountain Division, N. E. L. A., and the Colorado Public Service Association at the Hotel Colorado, Glenwood Springs, Col., September 14-17, have been announced by E. A. Phinney, general manager of the Jefferson County Power & Light Company, who has been designated as general convention chairman by the heads of the two organizations. The convention this year will be one day longer than has been the practice for more than twenty years, and business sessions will only be held in the morning instead of twice a day as heretofore. This arrangement will provide more time for sports and entertainment and at the same time will increase interest and attendance at the daily sessions.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published on page 50 of this issue of the ELECTRICAL WORLD.]

East Central Division, N. E. L. A.—Breakers Hotel, Cedar Point, Ohio, July 14-17. D. L. Gaskill, Greenville, Ohio.

North Central Division, N. E. L. A.—Duluth, Minn., July 15-17. H. E. Young, Minneapolis General Electric Co., Minneapolis.

International Association of Municipal Electricians—Hotel Statler, Detroit, Aug. 17-20. W. R. Arbuckle, Bayonne, N. J.

Wisconsin Utilities Association, Electric Section—Green Bay, Wis., Sept. 4-5.

Camp Co-operation V (local leagues)—Association Island, Henderson Harbor, N. Y., Sept. 8-12. (Society for Electrical Development, New York, is sponsor.)

New England Division, N. E. L. A.—Hotel Griswold, New London, Conn., Sept. 8-11. Miss O. A. Bursiel, 149 Tremont St., Boston.

Pennsylvania State Association of Electrical Contractors and Dealers—Hotel Jermyn, Scranton, Sept. 10. M. G. Sellers, 1202 Locust St., Philadelphia.

Rocky Mountain Division, N. E. L. A.—Hotel Colorado, Glenwood Springs, Col., Sept. 14-17. O. A. Weller, 900 15th St., Denver.

Southeastern Geographic Division, N. E. L. A.—Birmingham, Sept. 15-18. E. T. O'Connell, Alabama Power Co., Birmingham.

Great Lakes Geographic Division, N. E. L. A.—French Lick Springs, Ind., Sept. 23-26. R. V. Prather, 305 Illinois Mine Workers' Bldg., Springfield, Ill.

Association of Electragists International—West Baden, Ind., Sept. 23-25. L. W. Davis, 15 W. 37th St., New York.

American Electrochemical Society—Chattanooga, Tenn., Sept. 24-26. Colin G. Fink, Columbia University, New York.

American Electric Railway Association—Atlantic City, N. J., Oct. 5-9. J. W. Welsh, 292 Madison Ave., New York.

National Association of Railway and Utilities Commissioners — Washington, D. C., Oct. 13-16. J. B. Walker, 270 Madison Ave., New York.

Electric Power Club—Briarcliff Manor, N. Y., Oct. 19-22. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

To Go Ahead with Hydro Plant on Niobrara River, Nebraska.—It is announced that the Northern Nebraska Power Company means to construct with its own forces the hydro-electric plant on the Niobrara River near O'Neill to which reference has already been made in these columns. This plant will contain three units of 1,500 hp. each. The power house will be built of concrete and will operate on a head of 16 ft. There will be a dirt fill 2,800 ft. long and a concrete dam 420 ft. in length. This part of the project will, according to T. H. Carter, superintendent of construction, cost from $700,000 to $800,000, and in addition the company will build a 150-mile transmission line at a cost of about $200,000, including substations and distribution lines.

Catskill Power Corporation Organized.—The Catskill Power Corporation has been formed to take over and develop the hydro-electric properties of the Rockland Light & Power Company system on the Mongaup River, New York. The plant at Mongaup Falls has an installed capacity of approximately 4,370 hp. In addition, there are partly developed and undeveloped water-power sites having a potential hydro-electric generating capacity in excess of 20,000 hp., with an estimated output of approximately 80,000,000 kw.-hr., and storage reservoir sites having a potential capacity of 3,000,000,000 cu. ft. The Rockland Light & Power Company, in conjunction with its subsidiaries, furnishes electric and gas service to a population of more than 102,000 in a territory extending for 30 miles along the west shore of the Hudson River. The Catskill Power Corporation will also buy the water-power plant on the Mongaup River near Middletown from the Orange County Public Service Company.

Siemens-Schuckert Plans for Developing Shannon River Condemned.—According to the *Wall Street Journal*, Theodore Stevens, an American engineer practicing in London, who has made surveys of the Shannon River in Ireland for the British government, attacks the Siemens-Schuckert plans, indorsed by the Free State government, both as an engineering and as a financial undertaking. His own proposals were for building several small stations at steps on the Shannon, on the Liffey and on other rivers. These would be built for local use on a scale in proportion to the needs of the community. He asserts that Siemens-Schuckert will have to build embankments averaging 12 ft. high for more than 100 miles and that an expensive drainage system for the whole region must be carried out. Once built, he doubts the capacity of the power station to do what is promised of it. "The Germans claim that with 36,500 volts they will transmit power to distant parts of Ireland over 200 miles from the Limerick station," Mr. Stevens says, "but experience elsewhere shows that 40 miles is about the limit which can be reached with this load."

Men of the Industry

W. H. Lines of Portland Receives Promotion

W. H. Lines, since 1923 construction engineer for the Portland (Ore.) Electric Power Company, was recently promoted to be assistant to the president, a newly created position in that company. After graduation from Cornell University in 1909 he entered the engineering department of the Rochester (N. Y.) Railway & Light Company, remaining until 1912, when he went to Portland to join the organization of what was then the Portland Railway, Light & Power Company. He spent four years with that utility as industrial engineer, specializing in power sales and power promotion, and one year as secretary to the president, resigning in 1917 to accept a position as plant superintendent of the Northwest Steel Company, Portland. After terminating this connection he started a manufacturing business of his own, but in 1923 he retired from active participation in this business to return to the Portland utility as construction engineer. In this capacity he was engaged principally in a study of the needs of the entire system from the generating plants to the customers' meters.

C. F. Kalp has been appointed treasurer of the West Penn Power Company to succeed the late C. C. McBride.

Robert Miller, who for the past five years has been local manager of the General Electric Company at Salt Lake City, has been appointed manager of the Rocky Mountain district, with headquarters in Denver. He succeeds Harry D. Randall, transferred to other duties at the main offices of the company at Schenectady, N. Y. Mr. Miller has been in the employ of the General Electric Company more than twenty-five years.

T. W. Reynolds has been appointed construction superintendent of the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., to succeed T. A. Corby, recently transferred to the Kingston (N. Y.) Gas & Electric Company, a subsidiary of the Central Hudson organization. Mr. Reynolds was formerly electric superintendent.

C. H. Bell, who for eight years has been manager of the Mobridge (S. D.) Electric Company, has been made superintendent of the municipal plant at Watertown, S. D. This change was made because of the purchase and reorganization of the Mobridge property and because the city of Watertown wanted a utility man to help it solve a difficult situation, not because Mr. Bell favors municipal ownership. Prior to his connection with the Mobridge company, Mr. Bell had spent seven years in Watertown developing electric service.

H. Bailey has been made general manager of the Northern Power & Light Company, Mobridge, S. D., which recently took over the Mobridge Electric Company, the Boyle Electric Company of Gettysburg, the Dakota Utilities Company of Eureka, the New Era Power Company of McLaughlin and the Sheets Electric Company of Lennon, S. D. L. P. Runkel is president and G. A. Stevens vice-president.

C. S. Ruffner Heads New Holding Company

Charles S. Ruffner, vice-president and general manager of the Adirondack Power & Light Corporation, Schenectady, has been elected president of the Mohawk-Hudson Power Corporation, the hundred - million - dollar utilities holding company now seeking authority to acquire the capital stock of five utility corporations serving the Mohawk and upper Hudson valleys. Mr. Ruffner's election was the culmination of twenty years of activity in the power

C. S. RUFFNER

field. Born in Chicago in 1880, he began his real work in the electrical field in 1900 with the Telluride Power Company at Telluride, Col., as engineer of the Colorado department. In 1904 Mr. Ruffner was transferred to the Utah division as assistant general superintendent.

Following this, after Mr. Ruffner had spent two years with the Central Colorado Power Company, the construction of the Keokuk plant on the Mississippi River was proposed, and he was called in by the St. Louis companies as vice-president and general manager, later being elected president of the Mississippi River Power Distributing Company. When the property was completed it was taken over by the Electric Company of Missouri and Mr. Ruffner was named as vice-president and general manager of the new corporation, which purchased and built lines over several counties surrounding St. Louis. The Union Electric Light & Power Company, with Mr. Ruffner as vice-president, was organized and took over the properties. In 1919 he was transferred to New York as vice-president of the North American Company, owner of St. Louis power properties and similar properties in Wisconsin and Ohio. He was in general charge of operations of subsidiary companies. Two years later he was made a vice-president and general manager of the Adirondack Power & Light Corporation with headquarters at Schenectady, and it was largely due to his efforts that the recent merger of the several companies in eastern New York, under the name of the Mohawk & Hudson Power Corporation, was brought to a successful issue.

Thomas E. Purcell, formerly mechanical engineer with Dwight P. Robinson, Inc., consulting engineers and constructors, New York, is now general superintendent of power stations for the Duquesne Light Company, Pittsburgh.

P. L. Paxton has been appointed electric superintendent of the Central Hudson Gas & Electric Company, Poughkeepsie, to succeed T. W. Reynolds, who has been transferred to the construction department.

Sir Clifford Sifton and **Harry Sifton** have resigned from the directorate of the Canadian Western Natural Gas, Light, Heat & Power Company, Ltd., and **C. J. Forath** has been elected president and managing director and **H. B. Pearson** vice-president and manager.

Thomas H. Haines, for the past twelve years assistant superintendent of the maintenance of lines department of the Edison Electric Illuminating Company of Boston, has been appointed superintendent of the department, succeeding the late J. E. Larrett. E. C. Rue will be assistant superintendent.

Frederic E. Webster, treasurer of the Portsmouth (N. H.) Power Company and affiliated utilities, has been appointed general auditor of the Community Power & Light Company, St. Louis. Mr. Webster is widely known in New England utility and accounting circles and has been active in N. E. L. A. affairs in the Northeast for many years. He has been succeeded at Portsmouth by W. A. Keinzle, formerly assistant treasurer of the Eastern Penn Light, Heat & Power Company, Pottsville, Pa.

Obituary

James E. Larrett, for more than twenty years superintendent of the maintenance of lines department of the Edison Electric Illuminating Company of Boston, died recently at the age of sixty-five. He entered the employ of the company in 1887 and was a native of Wellfleet, Mass.

Herbert S. Valentine, sales manager of the monorail hoist department of the American Engineering Company of Philadelphia, died at his home in Philadelphia on June 5 as the result of erysipelas. Mr. Valentine had had more than twenty years' experience in the design and manufacture of hoists, having been connected with a number of the leading manufacturers in this line in important engineering and executive positions. He was one of the organizers of the Standard Electric Crane & Hoist Company of Philadelphia and was chief engineer with that company when it was taken over in 1922 by the American Engineering Company.

Commission Rulings

Wisconsin Commission Recommends Graduated Service Charge.—The Wisconsin Railroad Commission has established a rate schedule for the West Dunkirk rural line which consists of a graduated service charge, increasing according to the size of the transformer used, and a two-step energy charge. The commission has further specified that the connection charge for additional consumers shall consist of an amount equivalent to the average investment for each consumer—the cost of the transformer, meter and other local equipment and any additional cost of the extension in excess of the initial connection charge. If the cost of the connection is less than the initial charge, the remainder shall be prorated among the consumers on the line.

Nebraska Commission Takes More Stringent Ground on Security Issues.—In passing upon applications from the Nebraska Electric Power Company and the Central Power Company for the approval of security issues, the Nebraska State Railway Commission announced a change of view as regards its duty in considering such issues. In the past, the commission said, it had approved applications where no evidence of fraud was manifest without itself weighing the question of whether or not the price paid for the properties on which the issue was to be based was extravagant. In other words, the commission demanded that those taking the risk of the future should back their judgment with their money. The commission now says: "As we now view the statute we are given the discretion to go beyond the fact of the purchase price and to give regard to whether the issuance of securities for the acquisition is justified. To limit our supervision to the mere function of approving whatever may be presented, so long as the element of fraud is not present, is to disregard the purpose for which the law was made."

Company Cannot Be Compelled to Increase Investment in Hope of Making It Pay.—An application by the Barnes-King Development Company for permission to discontinue service operated at a loss was granted by the Montana Railroad and Public Service Commission, although there was opposition on the ground that the company had made no attempt to increase its rates, that the company could increase its load by serving residents in another community and that there was prospect of active mining operations within a few months. The commission said that while ordinarily it would require any utility contemplating abandonment or suspension of public service to use every means at its command, including applications for rate increases to the commission, to continue to function, it would be idle in this case to petition the commission for a rate which would, on paper, defray its operating expenses, depreciation, taxes and a fair return on its investment, when such a rate was not within the zone of practical application and when, if it were, it would be so high that decreased use of energy would necessarily result and any possible benefit be thus wiped out. The commission also said: "The proposal that the company shall make an additional investment to extend its line to Brooks, to serve persons resident therein and farmers tributary thereto, the latter expressing a willingness to build their own connecting lines, entirely overlooks the fact that a public utility may not be compelled to extend its lines into a territory which it has not by word or deed actually undertaken to serve. We know of no principle of law that will compel investors in a public utility enterprise to attempt the salvage of an original investment by adding to it. Even overlooking these matters, there is nothing tangible in the offer to connect to the company's extended line and no assurance of a sufficient load to pay operating expenses thereof and a reasonable charge for the additional undertaking."

Commission Refuses to Consider Long-Delayed Protest.—In the case of Saint vs. Edison Electric Illuminating Company of Boston the Department of Public Utilities of Massachusetts ruled that electric consumers located on one street where service had been put underground at the expense of the utility, but receiving their energy from poles on another street, were under obligation to bear their share of the cost of putting their service underground after a change in the utility practice so as to require customers to bear such cost, in view of their failure to insist upon being included in the group of customers having service placed underground without charge at the time of such change. The commission said: "The case is unusual. If the petitioners are regarded as belonging to the Wallingford Road group and are compelled to pay for the underground work upon their respective premises, they suffer by comparison with the other users on Wallingford Road, who get this service for nothing. If, on the other hand, they are regarded as belonging to the Walton Road group and we exempt them from paying for the work upon their properties, they will, as a result, be preferred over all other users on Walton Road to just that extent. The real problem arises from the act that the petitioners belong in a sense to both groups and might perhaps by seasonable final election have created a definite right to be regarded as belonging to either of the two groups they chose. The opportunity for this was presented to them in 1921. When the company refused at that time to act upon their request to be treated as part of the Wallingford Road group, the petitioners had the right to apply to this department for redress, but they chose, instead of this, to accept the decision of the company that they belonged solely to the Walton Road group and to abide by that until quite recently. We think, in short, that in not persisting and enforcing their election and their rights—conditions meanwhile having changed radically—they waived whatever rights they had."

Recent Court Decisions

Utility Company May Promulgate Rates When Commission Fails to Fix Them.—The Michigan Supreme Court, in Walker Brothers Catering Company vs. Detroit City Gas Company, has overruled the inferior court and has upheld the common-law right of a public utility company to promulgate rates when none have been established by franchise, by the public service commission or in some other legal manner. Though the franchise had expired, the court said, "the property of the gas company continues to belong to it. It is not shown that the rates it is sought to collect are unreasonable. If the city thinks they are, it can easily take the judgment of the Public Utilities Commission. We think the trial judge was wrong in holding that the new rates, though reasonable, must fail because the commission had not acted upon them."

Company Not Responsible for Accident Occurring During Special Operation of Which It Had No Knowledge.—In the case of O'Donnell vs. Baker Ice Machine Company and others the Supreme Court of Nebraska ruled that a power company was not responsible for injuries to any one from electricity in the company's wires when the accident occurred in the course of special work of which the company had no knowledge. The case was brought by a structural ironworker against the Baker Ice Machine Company, upon whose plant he was working, and the Nebraska Power Company. The workman had been injured when a cable on a crane touched one of the power company's lines. The derrick was in an alley that had not yet been condemned for the ice company plant, and the power company had not been notified that the crane was being moved through the alley where the wires were in the way. (203 N. W. 635.)*

Power Company's Liability for Negligence Not Removed Because Damages Are Paid by Another Under the Compensation Law.—The Court of Appeals of Georgia has ruled, in Rome Railway & Light Company vs. Jones, that even though an employer paid compensation to the family of one of his employees who was killed by contact with the power company's wires, the power company was also liable for the man's death. The employee while working on the erection of a building had hold of a cable attached to a derrick and was killed when this cable came in contact with a power wire on which the insulation was defective. The court held that since the accident was due to the company's negligence in having a poorly insulated wire hung lower than the city ordinance specified, the power company was liable for damages irrespective of the operation of the workmen's compensation law. (127 S. E. 786.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

Electrical Jobbers' Margins*

An Analysis by Commodities Based on a Survey of Twenty-one Houses—A Comparison with Other Lines—Advantages and Disadvantages Discussed

By W. R. Herstein
Vice-President Wesco Supply Company, Memphis, Tenn.

IT HAS been well said that one-half of the world does not know how the other half lives. In the business world the paucity of knowledge is even greater, and it is probably true that no specific 10 per cent of the nation's merchants know much of the business carried on by the other 90 per cent. Unfortunately, opportunities for securing information of this character are limited. In the first place, the average merchant is so engrossed in his own affairs that he has neither the time nor the inclination to investigate his neighbor's. Even were he so minded, he would probably hesitate before asking questions concerning the more intimate details of another's business affairs.

For my own part, I think the figures obtained in a survey show, and my talks with those furnishing them indicate, that there is little difference between the electrical jobbing business and others. It will be seen that on the whole the gross earnings of most of the lines selected are fairly comparable with our own. Where these earnings are notably higher or lower, operating expenses correspondingly fluctuate, so that net results are about the same, leaving ample opportunity for the rewards to be gained by efficiency in operation. The only strikingly outstanding difference seems to be that for an equal area of territory covered the available volume of business in the electrical field is small, compared with that of groceries, hardware, dry goods, etc. As a consequence the net return on invested capital is much lower with us than in the case of these other concerns, even though their net margin of profit may be lower than ours.

*From an address before the meeting of the Electrical Supply Jobbers' Association, Hot Springs, Va., June 3-5, 1925.

Other Lines Have Large Volume

For example, an electrical jobber in a city of 200,000 population, enjoying a volume of $1,000,000 per annum, with an invested capital of $200,000, may earn 2 per cent net on sales, or 10 per cent on his capital. An aggressive hardware jobber in the same town and with the same capital may easily secure a volume of $2,500,000 and, with a net profit of 1½ per cent on sales, earn nearly twice as much return on his average investment. In order to form a basis for comparison it was first necessary to ascertain what was the operating income earned in the electrical jobbing lines. To accomplish this, I took the figures of our Memphis house and submitted them for comparison and correction to twenty-five members of the Electrical Supply Jobbers' Association. The majority of these members submitted their own figures in return, and I wish to thank them for their prompt and hearty co-operation.

Lines Show Wide Variation

A glance at the chart of electrical jobbers' margins, included herewith, will show a wide variation of earnings on identical lines. These figures should be valuable to our esteemed counsel should he ever be called upon to disprove the allegation that there is a uniformity of prices among the members of this association. A variation in gross earnings on loom, for instance, of from 4.8 per cent to 26.5 per cent would clearly indicate a lack of mutual understanding between these two jobbers at least. A range of 11 per cent to 32.2 per cent on boxes and fittings would confirm the suspicion that electrical supply jobbers are not working under the conditions of remuneration which Congress, in a spirit of paternalism, has accorded to the railroads, the labor unions and the orange growers.

The most serious handicap encountered in gathering this information from our own ranks was the question of freight. Owing to the lack of a

ELECTRICAL JOBBERS' MARGINS, BY COMMODITIES, BASED UPON ANALYSIS OF TWENTY-ONE HOUSES
Jobber's Selling Price = 100 per Cent.

Jobber No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Average
Miles from New York...	0	200	300	500	600	700	700	700	800	1,000	1,000	1,000	1,200	1,200	1,200	1,500	1,500	2,000	2,500	3,000	3,000	Margin
Freight included		No	No	No	No	Yes	Yes?	Yes?	No?	Yes?	Yes?	Yes	No	No	Yes?	Yes	Yes?	Yes?	No?	Yes	Yes	
1. Radio	16.6	21.3	18.8	21.3	19.9	21.5	22.0	20.9	21.6	19.7	19.1	20.3	21.6	20.0	....	18.3	20.1	....	19.2	20.2	20.0	20.1
2. Washing machines	20.0	14.6	19.3	....	16.0	18.7	20.0	....	16.5	18.9	16.9	18.5	18.2	....	....	13.7	15.9	....	15.8	13.2	....	17.1
3. Vacuum cleaners....	23.2	25.5	16.6	18.3	20.8	20.8	20.0	....	28.5	18.9	19.2	24.3	20.0	....	....	18.9	24.7	....	17.6	12.7	....	20.6
4. Fans	15.9	13.9	17.8	12.3	13.3	21.1	15	12	16	19.6	15.9	17.0	16.8	15.8	....	16.5	20.1	....	15.4	17.6	15.2	16.1
5. Ranges		11.0	22.1	10	19.1	....	....	13.3	10	18.3	17.5	13.0	08.4	6.0	....	14.9	13.5	....	9.8	08.3	....	13.0
6. Heating devices.....	16.7	13.9	17.4	16.6	17.3	13.4	....	17.5	16	18.3	15	15.9	16.3	11.6	14.2	16.4	17.0	....	13.7	15.0	14.3	15.6
7. Portables		32.5	....	20.0	....	....	....	....	22	....	19.7	26.3	20.0	....	17.0	....	20.2	....	22.4	20.2	20.0	21.8
8. Incandescent lamps	15.8	....	10.6	13.2	10.4	9.5	12.8	16.3	17.5	12.1	15.9	13.1	15.8	14.0	....	13.0	12.4	....	15.8	11.7	13.0	13.5
9. Flashlights and batteries		24.4	21.8	26	....	26.6	....	22	22	26.1	24.6	24.7	24.8	20.0	....	22.0	25.9	....	23	22.9	24.0	23.7
10. Dry batteries.....	21.1	18.0	19.7	29.1	....	17.5	....	20	25	21.4	24.2	18.7	27.4	20.0	....	19.0	19.4	12.5	21.7	21.2	27.7	21.3
11. B batteries.....	20.6	....	....	20.1	....	....	....	21	21.5	....	24.2	20.3	21.3	20.5	....	19.0	24.2	....	22.9	21.0	20.6	21.3
12. Battery chargers....	19.0	....	....	20.2	....	....	22	18	25.5	....	21.6	22	26.8	....	17.2	....	21.6	....	....	25.1	21.4	21.7
13. Wiring devices.....	10.7	17.7	14.8	17.5	14.6	16.2	18.6	19.7	20.4	20.3	22.4	22.3	19.5	15.0	14.5	19.8	20.9	12.5	26.7	22.7	22.0	18.5
14. Rubber-covered wire	11.2	14.0	12.7	15	14.0	16	....	14.2	17	15.4	....	15.3	12.9	10.0	....	13	12.6	10.0	15.2	13.5	11.5	13.5
15. Iron conduit.....	11.9	13.7	12.7	10.9	....	10	12.5	12.9	....	13.8	....	15	12.5	13.0	....	13.4	16.7	10.0	24.5	12.0	12.2	13.4
16. Loom		12.2	13.8	18.2	13.7	4.8	....	12	23	....	....	21.5	22.7	20.0	15	15.9	16.2	18.0	26.5	20.1	21.5	17.4
17. Porcelain		34.1	31.3	29	....	21.5	23.5	18	29.0	42	....	27.4	24.9	38.6	29.0	24	20.4	22.9	22.0	20.3	22.3	20.0	26.3
18. Boxes and fittings..	16.8	32.2	22.5	20	23.3	....	27	11.0	26.5	....	....	23.5	25.0	29.0	....	13.5	14.2	15	30	23.6	15.0	20.3
19. Safety switches.....	12	16.8	21.7	22.1	19.3	15.6	22	19.3	22.5	15.4	14.3	20.7	19.2	18.0	....	21.8	19.4	15	13.5	23.2	11.5	18.1
20. Panelboards		12.6	11.9	09.2	10.8	....	....	16.0	16.0	....	16.9	15.8	16.0	16.0	10.0	11.0	12.1	....	16.6	08.4	21.4	13.8
21. Residence lighting fixtures	23.6	31.6	15.6	....	23.1	....	....	28.0	23.6	20.8	21.3	26.3	21.0	....	25.0	25.8	28.1	....	18.6	18.2	....	23.4
22. Commercial lighting fixtures	21	32.8	22.4	20.0	23.1	18.3	....	24.0	23.6	20.8	21.3	26.3	20.3	20.0	21.0	25.8	29.9	....	26.3	17.1	20.0	22.8
23. Weatherproof wire.....		04.4	11.2	11.0	11.2	....	....	09.7	11.2	04.2	....	11.6	09.5	10.0	....	06.6	05.7	....	14.0	07.8	13.4	09.4
24. Line material.....		22.9	15.3	20.0	16.2	25.4	10	18.4	19.6	13.8	20.1	13.3	16.0	15.0	09.7	13.7	11.8	....	12.1	17.0	....	16.1
25. Transformers.....		11.7	13.8	12.3	....	23.9	10	11.1	10	12.5	11.8	08.7	12.1	11.0	11.0	15.7	11.5	....	11.6	15.4	....	12.6
26. Meters.....		09.3	11.3	12.2	....	....	10	12.0	10	12.5	10.2	09.0	09.7	10.0	10.0	16.2	10.9	17.5	9.1	14.2	....	11.4
27. Motors.....		12.4	11.7	10.5	....	16.1	10	07.0	09.0	11.1	13.6	09.0	08.4	12.0	....	16.6	10.2	10	12.6	....	....	11.3
Averages.....	17.3	18.9	16.9	17.4	17.1	17.7	16.6	16.9	19.7	16.7	15.1	17.6	18.4	16.2	15.7	16.8	17.8	14.2	18.2	17.1	18.1	....

Gross margin, 16.2 per cent. Total expense, 14.1 per cent. Average turnover per annum, 3.6.

uniform accounting system, the figures furnished by some jobbers included the addition of freight and those of others did not. The jobbers who stated clearly that their figures did or did not include freight are so indicated. Entries followed by a question mark represent my own guess after careful comparison of their figures. Strange to say, however, the matter of freight does not seem to affect the figures materially, except in the case of commodities where the degree of fabrication is very slightly removed from the raw material, such as porcelain, conduit and boxes. On articles highly fabricated a comparison of gross earnings between different jobbers shows little susceptibility to the influence of freight.

Whether or not the items of cash discount and annual rebates enter into the figures I am unable to say. It is possible that extreme variations may be accounted for in this way, but I believe it is the common practice to omit them from consideration in data of this character. The presence of these factors of uncertainty, I realize, affects to a greater or less degree the value of the figures as presented, but, as before explained, the lack of a uniform accounting system makes this disadvantage unavoidable. So far as I know, there are no other figures of this character available in our own industry, and I am simply presenting them for what they may be worth, with a free acknowledgment of their possible inaccuracies.

Taking up, now, the figures which I have secured in other lines, I wish to say that I was impressed with the number of non-electrical jobbers who have no data covering the earnings on their different commodities. While they all knew their average operating income for the entire business, the majority of those interviewed could give me little or no information of the character I sought. In addition to seeking information concerning gross earnings on the various lines handled, I endeavored to ascertain trade conditions and practices in the different industries, and I feel quite certain that we share our successes and failures, our trials and triumphs, largely in common with these other jobbers.

The periodic cycles of prosperity and depression which we know so well are equally well known to them. They are acquainted with the phenomena of buyers' market and sellers' market the same as we, and they know the bitterness of unrestrained, unintelligent and unfair competition. In practically all their lines they encounter the buyer who claims to buy at prices lower than the jobber's own cost. They encounter also the jobber who attacks a well-established and nationally advertised product for unethical purposes and who all too frequently justifies these super-buyers in their extravagant claims.

In their industries, as in ours, they find persistent efforts to eliminate the jobber; and they are harassed, as are we, by that type of manufacturer who accepts business wherever it may be found, selling to the jobber in the morning and to the jobber's customer in the afternoon, with this marked difference, however, that in no other industry did I find manufacturers in competition with their own distributors, as is notably the case in our industry with manufacturers of conduit, poleline material, heating devices and perhaps a dozen other lines.

If from these data it should appear that the electrical supply jobbing industry is really worth while, I shall feel satisfied with my effort. On the other hand, I hope to have sounded a note of warning to outsiders that the industry is not an easy road to wealth. There is no substitute for hard work in the electrical supply jobbing business. With diligent application, sufficient capital and a reasonable amount of intelligence, it will pay fair returns upon the effort invested. To those outsiders contemplating handling it as a side line I would say frankly that it can't be done. I can instance a number of jobbers in hardware, mill supplies, plumbing and kindred lines who have learned this at considerable expense. They have all either discontinued the effort, set up separate businesses, or are continuing the experiment at a heavy loss.

The business is too extensive for the mere department of a non-electrical jobber to compete successfully with a full-fledged electrical house. The majority of electrical buyers will not take seriously the hardware salesman who tries to sell electrical goods as a side line. In fact, I believe our own members, many of whom are engaged in the automotive supply business, have found this distinct disadvantage in unrelated lines, that they require entirely separate treatment and different types of salesmen and that their main point in common is that the businesses are conducted under one roof.

JOBBERS' MARGINS IN OTHER LINES OF MERCHANDISE

	Margin in Per Cent
Plumbing	
Cast-iron soil pipe and fittings	25.0
Plumbers' brass goods	22.5
Wrought-iron and steel pipe	21.5
Brass pipe	20.0
Enameled ironware (bathtubs, lavatories and kitchen sinks)	18.0
Cast iron and malleable pipe fittings	17.5
Brass pipe fittings	17.5
Plumbers' lead products	17.5
Cast-iron heating boilers	15.0
Cast-iron heating radiators	7.5
Automotive Equipment	
Springs	33.3
Brake linings	30.5
Motometer	26.8
Shop equipment	22.0
Spark plugs	21.5
Horns	20.8
Chains	18.8
Bumpers	17.7
Gross margin	24.9
Operating expenses	23.4
Net earnings	1.5
Turnover, per annum, times	3.4
Losses from bad debts, per cent	0.7
Hardware	
Pocket cutlery	25.0
Flashlights, batteries, bulbs	22.5
Farm implements	22.0
Glassware and queensware	21.9
Auto accessories	20.2
Stoves and ranges	20.1
Tools, hatchets, axes	19.0
Household specialties, refrigerators, etc.	18.4
Harness and saddles	17.9
Prepared roofing, building paper	15.8
Cotton rope and other cordage	13.1
Screen wire	11.4
Metal roofing	10.2
Drugs	
Bulk dry goods	25.0
Fluid extracts, elixirs, tinctures	22.0
Rubber and bristle goods	22.0
Stationery	22.0
Patent medicines, non-secret formulas	20.0
Candy	20.0
Soda fountains and fixtures	20.0
Perfumes and cosmetics	18.0
Glass bottles	18.0
Patent medicines	15.0
Paints	15.0
Chemicals	14.0
Lead and oil compounds	10.0
Tobacco	10.0
Gross margin	17.2
Expenses	16.3
Net earnings	0.9
Stock turnover per annum, times	3.6
Losses from bad debts, per cent	0.4
Dry Goods	
Millinery	25.0
Queensware	24.0
Men's hats	22.0
Silks	20.0
Dress goods	20.0
Shoes	20.0
Notions	20.0
Hosiery	18.0
Overalls	17.0
Carpets and rugs	16.0
Ginghams	15.0
Linoleum	14.0
Duck	12.0
Sheetings	11.0
Window shades	10.0
Threads	10.0
Gross margin	17.6
Total expense	16.6
Net earnings	1.0
Stock turnover per annum, times	3.4
Losses from bad debts, per cent	1.0

DISADVANTAGES OUTLINED

In summing up, I should say that the main disadvantages of our industry, as contrasted with other jobbing businesses are:

1. The disposition of the manufacturer to eliminate the jobber in handling the business of buyers with comparatively large buying power and of good credit rating.

2. The disposition of many manufacturers to disregard recognized trade channels and customs in seeking business where they have no satisfactory outlet, and an unwarranted readiness to create so-called jobbers in such cases.

3. The attractiveness which the term "electrical" seems to possess for jobbers unfamiliar with the business.

4. The continued concentration of central-station buying power in the hands of a comparatively small number of people. The thought here suggests itself that the jobber's central-station business may yet go the way of his former telephone business.

ELECTRICAL JOBBER HAS ADVANTAGES

In order that the picture may contain sunshine as well as clouds, however, it is possible to enumerate certain distinct advantages.

1. The possibilities of the business are apparently unlimited. New devices and new uses for old ones are developing constantly. The point of saturation is far from reached.

2. Transmission lines are gradually making potential customers of almost the entire population.

3. The largest manufacturers are evidencing an increasing conviction that they need the jobber.

4. The abler men among our contractor-dealer customers have admitted an identity of their interest with ours.

5. The examples of men who have achieved notable success in the electrical supply jobbing business furnish inspiration for every member of our industry.

Cost of Making Special Apparatus*

Many Indeterminate Overhead Charges in Ascertaining Cost—First Order Should Pay All Development Expense—Policies of Various Companies Outlined

BY C. H. ROTH
President Roth Brothers & Company, Chicago

THE practice of various manufacturers and the individual ideas as to what should be figured into cost, and also the proportion of such cost the manufacturer and customer should bear, may be classed as indicating the scope of this article. In the last analysis, if the manufacturer is making a profit on his whole business, then his customers are paying such costs. Nearly all correspondents have called attention to one outstanding feature in connection with the cost of special apparatus that must not be overlooked when making an estimate or when ascertaining the cost of the apparatus. It is the unseen, unheard and often unrealized cost that never finds its way to time tickets. It is the time spent by executives in consultations, time used by superintendents, foremen and other overhead employees not accounted for, and the disturbance such special apparatus causes in all departments of the establishment. Such overhead is usually out of all proportion to the overhead cost of standard apparatus. Even on standard apparatus the quantity has a very great bearing on the cost. Experience proves that an armature or a bearing bracket, for instance, can easily cost from one and one-half to six times as much as one included in regular lots of production. If the variation is so evident on regularly made apparatus, it must be more so in connection with special apparatus.

ONE METHOD OF COMPUTATION

Just imagine—or, better, figure—what your output could be if you were making only standard apparatus in quantities; get the percentage of your standard and specials, and you will be able to form at least an approximate idea of what the "specials" cost and whether or not they are profitable.

Why are special machines or apparatus made? For whose benefit? Undoubtedly, for the customer's benefit, because he needs or wants them. If, therefore, the special apparatus is for the benefit of the customer, why should he not pay all cost of making the apparatus? This is particularly true if the machines are being made entirely for this customer and are not suitable for general sale. True, there are some cases where the first machines are special but may have such great possibilities of general sale that the manufacturer may be glad to assume the burden of development if he is privileged to place them on the general market.

PAYMENT FOR DEVELOPMENT

Having decided that the benefit is entirely with the customer, it is next in order to determine the conditions upon which the manufacturer will accept the business. Quite frequently, the customer talks in large figures and wants the development costs to be nothing, or at any rate spread over a large quantity, although he will want to order only a small quantity at first. In other words, he expects his special machines to cost him no more than the standard run. This is where the manufacturer must use good judgment and carefully explain to the customer where the real cost of making special apparatus comes in. Experience has taught all of us that in a very large proportion of cases the only safe way is to make the first order pay all development costs.

It is very desirable, when you undertake the making of special apparatus, that your customer shall get the feeling that your organization is really working for him and you are performing a service special only to him, and, this service being special, he must understand that the cost will necessarily be more than for standard apparatus and should really return a greater profit to the manufacturer.

There is a general feeling, properly founded, that special work in small quantity in itself is not profitable, and if no future business is in sight as an incentive, most manufacturers do not readily accept orders for special apparatus. We must not forget, however, that what is undesirably special for one manufacturer or too small a quantity for a large manufacturer may fit in quite nicely or be a very desirable quantity for a small manufacturer if priced on a proper cost basis.

COMMENTS BY VARIOUS COMPANIES

One manufacturer says he has the feeling that there is practically no profit on special apparatus, because of the difficulty of properly applying all overhead. Therefore the costs that are found do not cover the loss incurred by reason of curtailed output of standard apparatus. Extra chasing, supervision, foremen's, superintendents' and executives' time should be included in costs. In many cases also a real sizable item of expense is the preliminary sales engineering work involved.

In another case it is stated that the real cost is usually much greater than the cost that is found from the direct time tickets and material lists, because there are numerous demands for assistance from superintendents, foremen, inspectors and others whose time is not accounted for but whose time notwithstanding has been expended on the job. There is also frequently the element of extra and special appliances and tools found necessary that have not originally been planned for. Engineering is usually a very important part of the cost of a special job in the electrical business. It would include the actual cost of engineering calculation, drawings, the overhead for the department, the chief engineer's time and often the time of other important officials of the organization in consultation, which time should be at least estimated if not otherwise kept. Naturally all pattern cost must be charged either against the job, or spread over future orders. If changes are necessary in patterns, this cost must also be included.

Another company says that when something is required which is not listed in its catalog, quite a wide range of variation may be covered without any appreciable difference in the cost of material involved. There is, however, extra cost for the engineering time required in making design, and the work of the planning and follow-up departments in tracing through a small consignment is considerable, as compared with standard production. If no special work of any kind was done, no engineering department would be needed.

HOW ESTIMATES ARE MADE

Various plans and ideas are used in making up the estimate of cost of special apparatus. Estimates should be made in more or less detail, depending upon the experience and past success of the estimator. Proper records of the estimate should be made and these should be compared with the actual costs when the work is completed, including in most cases some percentage for the unseen, unreported time. P. E. Chapman, in the *American Machinist*, says: "The writer, who is now turning gray, has noted the degree of accuracy usually attained in estimating costs. In his experiences it seems to run about as follows: The estimator who has had limited experience in shop procedure or has seen few of the bills the job shop has to meet, and who thinks his boss wants the work, will be inclined to exaggerate a bit and will estimate anywhere from a twentieth to a tenth of the final actual cost. If he hedges a bit or just tries to be honest and accurate, he might go as high as an eighth of what the finish will show. Should he, by chance, have a bit of shop knowledge from barking his knuckles on the job in the past, his figure would even come up to a quarter too low. If he did his share in the shop before he started to push a figuring pencil, say ten or fifteen short years of job work, he will know just a few of the troubles that happen. Then, perhaps, if he has nerve, the figure he makes will be close, just a little short as a rule. Should this same 'buddy' quit estimating as a job and risk a bit of his own good cash on a contract or so, his ideas of cost will get quite a jolt. If he keeps his head up and stays in the game for say ten more years, he begins to realize there may be a word called 'profit.' If his nerve is still with him, he will figure some more, and some day, perhaps, his slogan, 'We want the job,' will change to 'We want the profit on the job.' That's where I stand now, and I've turned gray getting there, but I'm going strong and my prices are right for both sides, and some one else can be the Christmas tree."

The methods pursued by different manufacturers are as follows:

"Our practice is to figure the cost of material, labor and burden in the usual

*From an address made before the Electric Power Club at its meeting at Hot Springs, Va., May 25-28, 1925.

way, and if special engineering attention, new patterns, dies, tools, or other equipment are necessary, then a charge is added to cover those items."

"Where the order calls for quite a quantity, we try to get any special engineering, pattern or jig work included in the first lot, but sometimes we take a chance and absorb these items where we feel certain of repeat orders."

"In determining overhead for special apparatus, it is our custom to add 25 per cent to our regular overhead charges."

"We figure this the same as standard apparatus except that there is always an item of special development included, and actual labor charge is from 5 to 10 per cent higher, due to the fact that the costs are figures on day-work basis rather than on piece prices."

"The engineering department makes a careful estimate of material and labor costs. To its figures we add from 2 per cent to 10 per cent for contingencies. We then add our regular overhead and estimated margin, which varies with the character of the equipment and the contingent liability."

"Materials and labor, including material and labor for making drawings and patterns, are definitely determined and applied to the job. Regular overhead is applied, and in addition 25 per cent is added to cover the unseen costs of handling and the extra attention that must be given to special apparatus by foremen and others."

"The cost estimate of manufacturing special apparatus we determine from past experience and from the cost of orders for similar apparatus. Frequently some parts of special apparatus are almost identical with standard parts, and it is found desirable to figure the cost of the several assemblies or 'parts' (as distinguished from 'pieces'), such as commutators, complete armatures, complete bearing brackets, frame assemblies, etc., for comparison with similar parts of other sizes and types."

"The policy we have followed for years in determining the cost of special apparatus is to estimate the cost of engineering work, patterns and special tools and prorate the cost over the entire quantity of machines on the first order. This cost of development is not put in as a separate item, but is included in the quotation made. This development cost is deducted from subsequent orders. We are firm believers in the policy of including all development costs in the making up of costs of special apparatus."

"We endeavor on special apparatus to see that direct time is charged against such apparatus by every one in the shop, including foremen, superintendents and inspectors and that class of labor which would not be generally applied as direct labor. Included also in the shop cost and imposed on the initial order are all jigs and fixtures necessary for the manufacture of the apparatus."

"No attempt is made to make jigs, fixtures, gages, etc., for special apparatus that we are reasonably sure will not be manufactured again. This necessarily means that all material has to be laid out by hand without the use of jigs, fixtures, etc. All drilling has to be done singly and each piece machined separately, thereby also requiring a higher class of mechanic than standard production, and if such increased cost is not automatically accounted for in the regular cost estimating scheme, then it should have special consideration in the cost estimates so that sight of it will not be lost."

"For apparatus which is entirely special, involving the making of patterns, punches and dies or other new development, and where we make up a few devices only, we make the best possible estimate of cost based on past experience. However, where large quantities are involved, we quote on one or more samples, usually indicating all development charges as a separate item, giving our best educated estimate on costs. If we are ordered to make the samples, we keep very careful costs on everything and from the experience gained we quote upon quantity lots."

"If a large order is pending, a good plan is to take the order conditionally—say on a basis of furnishing 10 per cent of the total requirements at a fixed price to include a good part of the development cost, so the customer will have some investment in the development. The manufacturer will be able, from his experience with the initial trial order, to make an intelligent price for the rest of the order, and the customer may have the privilege of canceling the rest of the order if he is not satisfied with the price made. With this plan there is not much to lose or gain on the initial shipments, but each party to the transaction having some investment in the proposition can feel that a fair price will result on future deliveries. Good faith and a clear understanding between the two parties are a great help in closing such deals."

There is need for a complete understanding in the making of special apparatus. Guarantee of performance, workmanship and delivery should be quite definitely understood if the job is of any importance, as lack of a clear understanding may lead to serious complications and losses. Points to be watched for in making up cost estimates are at least partially covered by the following suggestions:

(a) Cost of sales effort, if extraordinary, including preliminary tests, investigations, consultations, etc.

(b) Cost of entering orders correctly, these being special, usually entails considerable cross-talk and inquiry about details that require the careful attention of a good class of employee.

(c) Cost of engineering time, including cost of design, drawings, specifications, special consultations, etc.

(d) Cost of patterns, punches and dies, special tools and fixtures, special shop machines, testing equipment, gages, etc.

(e) Cost of the extra labor due to hand layout work and the higher class of help required where no jigs, fixtures, etc., are provided, and wastage of time because of unfamiliarity with the work.

(f) Cost of waste materials in cutting special shapes and sizes and in making experimental pieces to determine proper proportions.

(g) Cost of spoilage of materials, because of unfamiliarity with the special machine work and windings, poor castings from untried patterns, mistakes on drawings, etc.

(h) Cost of extra parts that may have to be scrapped because of the necessity of providing a reserve factor to complete safely the whole order, unless a definite understanding is had that a plus or minus quantity will be satisfactory.

(i) Cost of special and unusual machines, possible prolonged testing, witness tests and consequent disarrangement of regular testing schedules and shipping promises.

(j) Cost of guarantee covering material and workmanship and actual performance in service. (The nameplate marking may have an important bearing on this point as tending to impose undue hazard on manufacturer.)

MAIN ITEMS OF COST

The above elements of special costs and the regular costs might be summed up under the general heads of cost of materials, cost of labor, cost of usual manufacturing overheads as regularly applied, cost of unusual manufacturing overheads as pointed out in the items above listed, cost of usual administrative overheads as regularly applied, and cost of unusual administrative overheads as pointed out in the items above listed. After the detailed costs are figured, checking of figures is desirable by a comparison of cost with similar or like mechanical sizes and types, a comparison of cost per pound with other sizes and a comparison of cost by torque rating in motors (Mr. Burke's "bogey" formula developed about fifteen years ago). Summing up, if the manufacturer is reasonably sure of his costs, he can usually come to a fair understanding with his customer, the requisites being common sense, good judgment, an honest "proposition" and enough backbone to stand by it.

Business Conditions

BUYING by central-station and railroad companies and industrial plants has been very good. A million-dollar order was placed by a central-station company for furnaces and fuel equipment, and two orders for a complete substation and a frequency-changer set totaled about $400,000. Several orders for wire, covering considerable quantities, were also received by manufacturers from all three sources, one from an industrial plant amounting to approximately $125,000. The demand from industrial companies for equipment has been strong, and in addition several interesting inquiries are in the market. Various sales campaigns on electric ranges have been productive of many orders, and manufacturers report a large increase in the volume of business as compared with last year.

Estimates show bookings of the General Electric Company for the quarter ended June 30 to be $75,000,000, which compares with $71,219,984 of actual orders for the corresponding quarter last year. Sales for the first half of this year would thus amount to about $159,000,000, comparing with $144,707,887 for the first six months of last year. All indications point to the fact that the seasonal decline of business will not be as much this summer as it was last year at this time, and manufacturers report conditions as healthy and more stabilized. The Radio Corporation of America has guaranteed the prices of vacuum tubes till December 31, 1925, against a decline.

In New England utilities and steam railroads have been the largest buyers of apparatus and line supplies. Heavy sales of power apparatus, and especially of motors below 50-hp. rating, were recorded in that district, and a sixty-thousand-dollar contract for lighting equipment was awarded at Lynn, Mass. Sales have been diversified and in good volume in the New York district. Some large orders were placed by central-station companies in that territory, and buying by industrial plants has been very good. In the Southeast the demand is spotty, with the boom condition in Florida and the industrial developments in Alabama serving to hold up the total volume of business. Electric range campaigns in the Southeastern territory have been productive of many sales. Most utility companies in the Middle West are placing or have placed orders recently for considerable quantities of wire owing to the increase in the rubber market, and business has been showing a steady improvement. On the Pacific Coast power-company buying is fair with some good orders placed for insulators, and sales generally have been good.

Demand for Copper Improves—Lead Price Again Declines

THE demand for copper has again improved, and producers have been able to book several orders at 13¾ cents. Individual purchases were small, but orders were placed in sufficient quantity to maintain the price. Export

NEW YORK METAL MARKET PRICES

	June 24, 1925 Cents per Pound	July 1, 1925 Cents per Pound
Copper, electrolytic	13¾	13¾
Lead, Am. S. & R. price	8.20	8
Antimony	16½	16½
Nickel, ingot	34	34
Zinc, spot	7.32½–7.35	7.35
Tin, Straits	56½	56½
Aluminum, 99 per cent	28	28

Base copper price July 1, 1925, 16 cents.

sales have also been much better. The American Smelting & Refining Company again reduced the price of lead to 8 cents on June 30. This made the fourth cut during the month of June. There appears to be little demand as consumers are holding off until they are assured that the market has stabilized. Consumers have shown better interest in the zinc market and prices have been firm. The tin market has been active owing largely to speculative buying, although there was a fair demand from consumers.

Utilities Place Many Orders for Wire in the Middle West

BUSINESS is steadily improving in the Middle West. Most utility companies are placing or have placed orders recently for considerable quantities of cable and other products into which rubber enters owing to the unusual activity in the rubber market. Construction work of central-station companies is well under way and purchasing by industrial firms is improving. An interesting order was placed this week by a utility company for about $100,000 worth of disconnecting switches, together with 150,000 lb. of weatherproof wire and cable and approximately 700 watt-hour meters. There has been an active demand for pole-line hardware and high-tension equipment, although the demand generally remains somewhat erratic.

Jobbers' sales have been quite satisfactory and indications point to a favorable month. Fan sales have been retarded somewhat by the unsettled weather conditions, but other socket appliances have moved well. Considerable quantities of flatirons, toasters and percolators have been sold, and a manufacturer of washing machines reports a single order for 500 machines.

Demand Spotty in the Southeast —Range Sales Active

LITTLE new activity is to be noted in industrial lines in the Southeast, and in certain sections the long drought has caused curtailment in power supply to some of the industrial plants. However, this has in no way affected central-station expansion programs and construction materials are in very active demand. Telephone equipment sales are satisfactory, particularly in Florida and the number of inquiries in hand is extraordinarily large.

Spotty conditions are reported by electrical jobbers. The boom condition in Florida and the industrial developments in Alabama are serving to keep up the total volume of business for the section. Extremely warm weather has, of course, sustained the brisk movement of fans. Some jobbers report range and appliance sales as quiet while a manufacturer says that his business is excellent, with the cumulative total range sales for the year 93 per cent ahead of the same period last year, and the increase in appliance sales is 28 per cent. The Southern Public Utilities Company has just completed a range campaign in which 902 ranges were sold in six weeks. This is equivalent to one range for every thirty-three customer prospects. The Carolina Power & Light Company sold approximately 400 ranges in a recent campaign, and other campaigns to be undertaken over the territory will further boost the total sales volume.

Utilities Buying Actively in New England District

ELECTRIC utilities and steam railroads are leading buyers in the Northeastern market for apparatus and line supplies this week, and many important central-station transmission development projects are coming to the front to enhance the outlook for good business. The spread of centralized management is so rapid that the sale of machinery, line supplies and appliances tends to increase steadily, despite local soft spots owing to depression in some textile centers. The demand for pole-line material of all sorts is surprisingly great. Heavy sales of power apparatus and especially of motors below 50-hp. rating are noted, the latter being from 5 per cent to 10 per cent ahead of a year ago. Two 1,500-kw. geared steam turbines for direct-current industrial-plant service were sold to a Rhode Island textile mill, and a Connecticut manufacturer of domestic oil-heating apparatus bought 1,000 motors of ¼-hp. rating. A rubber mill in Rhode Island purchased a 45-kw., 10-ton electric lead-melting furnace, and sales of electric heating equipment for special applications and for heat treating of steel are very active. Controller sales are excellent in volume. Industrial truck inquiries are more frequent. A sixty-thousand-dollar street-lighting equipment contract has been awarded at Lynn, Mass., on a development aggregating $150,000 in total cost.

Retail trade in New England is improving, and electrical appliance sales are fair. The demand for domestic refrigerating apparatus is growing by leaps and bounds. Irons, fans and portable lamps are moving well, and cleaner sales are responsive to energetic field work. New building is active in the residential field and contractors are reasonably busy.

Sales Diversified and in Good Volume in New York District

MANUFACTURERS report some large orders placed by central-station companies in the New York district. One order covered a complete substation at a cost of about $200,000, and another called for a frequency-changer set also having a value of about $200,000. A large order amounting to about $1,000,000 was placed with the Combustion Engineering Corporation for furnaces and fuel equipment for the new East River station of the New York Edison Company. A number of developments are anticipated within the next two weeks which should result in some further good-sized orders.

A large pole-line hardware order was received from a telegraph company for use in the Southeast. Sales of pole-line hardware to central-station companies have been steady, and though in comparatively small volume, are better than for the same period last year. Buying by utilities in upper New York State, which had fallen off owing to a change of administration, has again started. Wire manufacturers report many sales and that conditions are very encouraging. Railroad and central-station companies and industrial plants have all been placing good orders. One order received from an industrial company called for about $125,000 worth of wire.

Industrial plants are also active in the market for other equipment. An inquiry covering synchronous motors, control equipment, etc., for shipment to South America will total about $75,000. Several other interesting inquiries have been received by manufacturers. Jobbers report sales in June as better than in May, and despite a slowing up now, there is every indication that business this summer will be better than for the same period last year. Many small orders are being steadily received from industrial plants, contractors, etc. There is a strong tendency to improve lighting installations now rather than to wait till the fall, when there will be an immediate demand.

Power Company Buying Fair on the Pacific Coast—Sales Good

POWER company business on the Pacific Coast is fair. Several orders for insulators, both glass and porcelain, have been placed. One purchase of the latter covered about $2,500 worth of an 11,000-volt size. Government purchasing continues very good, presumably owing to final purchases at the end of the fiscal year that closed on June 30. Such orders are mainly for staple wiring items with a few socket appliances. San Francisco reports an order for X-ray reflectors amounting to $3,000. Important changes in a substation of the Puget Sound Power & Light Company will call for the expenditure of about $100,000, and much telephone and telegraph reconstruction work is scheduled to begin within two weeks.

The week's business has generally been very good and about evenly divided between staples and specialties. Rubber-covered-wire sales, which included an order for 250,000-ft. from a San Francisco contractor, reached a record aggregate probably because of a price advance. Conduit, roughing-in lines and schedule material sales were especially good. Jobbers reported a marked increase in their average daily number of orders over the previous week, with a corresponding increase in the number of special orders. An extremely hot spell during the week caused the first real fan movement of the year. Several good sales of radiators for school installation were also reported. Other interesting orders included 400 soldering irons for export to Japan, 2,000 soldering lugs of from 200-amp to 600-amp capacity and 1,000 ft. of 600,000-circ.mil single-conductor lead-covered cable.

Activities of the Trade

Combustion Engineering Receives Large Equipment Contract

A large contract has been placed by the New York Edison Company for furnaces and fuel equipment for its new central-station plant, being erected at Fourteenth Street and the East River, New York, with the Combustion Engineering Corporation, 43 Broad Street, that city. This contract involves an expenditure of about $1,000,000 and calls for a complete "Lopulco" pulverizing plant with water-cooled "Fin" furnace walls and a "Lopulco" ash transport system.

Eureka Vacuum Cleaner Men Meet in Chicago

At the annual meeting of 250 employees of the Chicago branch of the Eureka Vacuum Cleaner Company, held in Chicago on June 24, A. L. McCarthy, vice-president and general manager, reported sales of the company for the first quarter of 1925 to be 50 per cent ahead of the same period of 1924. That the market for the company's product is still far from saturated was shown by the fact that although sales of electric vacuum cleaners have increased throughout the past decade, there are today eight million wired homes without cleaners. The sales of the company have increased 150 per cent in four years. The sales of the Chicago branch, of which W. W. Fox is manager, are five times as great in 1925 as in 1920.

The Line Material Company, South Milwaukee, Wis., manufacturer of electric transmission and distribution equipment, has awarded a contract for the erection of a three-story factory addition, 80 ft. x 204 ft.

The Uehling Instrument Company, Paterson, N. J., manufacturer of the "Apex" CO_2 recorder and other power-plant instruments has appointed Charles M. Bullard, 912 Washington Street, Appleton, Wis., as its representative for central and northwestern Wisconsin.

The Strand & Sweet Manufacturing Company, Winsted, Conn., has received an order through Arthur Kent of London, England, for 20 tons of magnet and enamel wire. Mr. Kent, who recently visited the company's plant, said that the business outlook abroad is regarded as bright.

The Edison Electric Appliance Company, Inc., 5600 West Taylor Street, Chicago, announces the addition to its line of "Hotpoint" appliances of the model RA 73 automatic electric range. This range can also be used with the automatic electric timer by plugging it into the three-point receptacle at the rear of the range.

The Chicago Bridge & Iron Works, Chicago, have received an order from the Pacific Gas & Electric Company, San Francisco, for four "Wiggins" floating roofs for use on fuel-oil tanks. Recently the Southern California Edison Company, Los Angeles, purchased a "Wiggins" roof for installation upon a standby fuel-oil storage tank at the Seal Beach steam-electric generating station.

The Pacific Electric Motor Company, Oakland, Cal., announces that George B. Duncan, formerly a representative of the General Electric Company in the Oakland field, has been added to its staff.

The Pacific States Electric Company 236 South Los Angeles Street, Los Angeles, jobber, has established a branch office and warehouse at 220 South First Avenue, Phœnix, Arizona, with W. S. Mason, who has been covering the territory out of the Los Angeles branch, in charge. This move was said to have been contemplated for some time by the company and is now made in response to the generally improved tone of business throughout Arizona.

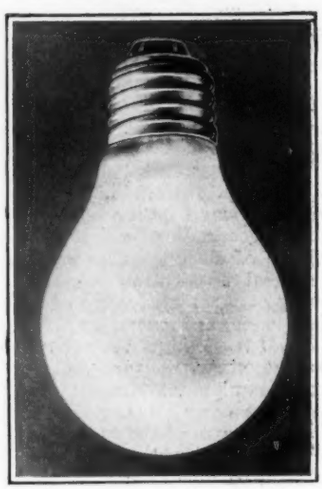
The A. J. Lindemann & Hoverson Company, Milwaukee, manufacturer of L. & H. electric ranges and appliances, announces that it has just placed on the market its new L. & H. electric waffle iron, model 315.

The Rockbestos Products Corporation, Nicoll and Canner Streets, New Haven, Conn., manufacturer of asbestos-covered wires and cables and heating elements, announces that in order to give better service to its customers the Chicago office has been moved from the First National Bank Building to the Madison Terminal Building, 9 South Clinton Street, where a stockroom has also been established.

New Equipment Available

New Line of Mazda Lamps

The first unit of a new line of "Mazda" lamps embodying what is said to be the most outstanding achievement of the last ten years in the art of incandescent-lamp manufacture has been announced by the "Mazda" lamp manufacturers. The principal feature of this new line of lamps is the inside frosting of the bulb which leaves the exterior surface smooth so that it will not collect dust or dirt. The inside frost is an excellent diffuser yet absorbs little more than a clear lamp. As the new line of lamps will replace both round and straight-side bulbs, a composite bulb, pear-shaped, has been adopted. Owing to improvement in the filament and other features of construction, the lamp is more rugged than previous lamps for general lighting service.



TWENTY-FIVE-WATT INSIDE-FROST "MAZDA" LAMP

The new line not only represents better light for less money but also embodies a program of standardization whereby the new lamps in possibly five sizes may eventually replace more than forty present types and sizes of lamps. The United States Department of Commerce is actively encouraging standardization and simplification in industry and consequently has indorsed this program. The first lamp of the new line is a 25-watt size, available to the trade since July 1. This lamp is intended primarily for residential use and may eventually replace twelve previously manufactured types of lamps, now made in four shapes, including straight-side and round type, and made in three finishes. Other units of the new line of lamps are being developed at the present time to take care of all general lighting service.

Grouped-Phase Power Panel

A new type of power panel has been placed on the market by the Square D. Company, Detroit. In addition to providing construction which makes it possible to use either 30-amp., 60-amp., or 100-amp, fuses in each circuit, this panel is arranged so that all the fuses of one phase are placed in one group. Each pole in the circuit receives a number, making it easy to distinguish the specific circuit. This number is stamped on the busbar where it will always be visible. The phases are placed in the cabinet so that the main lugs can be grouped at the top of the cabinet and the main lines can be brought in at one point. The design is said to be very compact, making it possible to keep the cabinet dimensions comparatively small.

Stationary Tachometer.—A stationary tachometer for the continuous indication of speed, known as the "Jagabi type B," has been placed on the market by James G. Biddle, 1211 Arch Street, Philadelphia. The instrument operates on the centrifugal principle, runs in either direction, is said to be remarkably smooth-running and dead-beat. It is operated by means of a round belt and pulley, the latter mounted on a shaft having ball bearings. The pedestal on which the instrument is mounted is made of aluminum. Ranges up to 8,000 r.p.m. are available, but the instrument is recommended chiefly for indicating speeds between 150 r.p.m. and 1,200 r.p.m.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase or agency is desired in Bristol, England (No. 15,723), for electrical specialties and radio supplies.

Purchase and agency is desired in Mexico City, Mexico (No. 15,616), for electrical hospital appliances.

An agency is desired in Lima, Peru (No. 15,725), for small lighting plants for home and farm use.

An agency is desired in Valencia, Spain (No. 15,724), for radio sets and parts.

An agency is desired in Elberfield, Germany (No. 15,637), for tools, pumps, fittings and transmission supplies.

An agency is desired in Oslo, Norway (No. 15,640), for engine lubricators.

An agency is desired in Bergen, Norway (No. 15,641), for motor-driven ice cutters (saws).

New Trade Literature

ELECTRIC APPLIANCES. — "Hotpoint Servants" is the title of a booklet issued by the Edison Electric Appliance Company, Inc., 5600 West Taylor Street, Chicago, covering its "Hotpoint" electric appliances, including electric irons, percolators, vacuum cleaners, electric miniature ranges, table stoves, toasters, waffle irons, etc. Supplements are also included calling attention to its new "Hotpoint" toaster, grill, traveling iron and electric range.

FLOOR BOXES AND FITTINGS.—The Adapti Company, 2996 East Seventy-sixth Street, Cleveland, has issued bulletin No. 107-C, describing the various types of the Adapti floor boxes and fittings.

ELECTRIC CRANES, HOISTS, SPEED REDUCERS, WINCHES, ETC.—The Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has issued an illustrated descriptive price list and catalog, No. 84, which describes and illustrates the various types of the Shepard crane and derrick hoists, speed reducers, back-geared electric motors, industrial contractors' and hauling winches. It contains construction details of its products and illustrations showing typical installations.

RESISTANCE-MEASURING INSTRUMENTS.—Herman H. Sticht & Company, 15 Park Row, New York City, has issued bulletin No. 130, which describes two types of model "D" megohmer—a combined megohmeter and voltmeter.

DIESEL ENGINES.—"Modern Methods in Diesel Engine Building" is the title of bulletin No. 1040 issued by Fairbanks, Morse & Company, Chicago, which describes and illustrates their method of manufacturing internal-combustion engines, begun thirty years ago. It contains illustrations showing the various stages of construction from the selection of the material to the finished machine. The company is also distributing bulletin No. 1,031, describing the operation and construction of its type "Y," style VA, oil engine, originally placed on the market twelve years ago.

AUTOMATIC EQUIPMENT.—The Monitor Controller Company, 500 East Lombard Street, Baltimore, has issued bulletin No. 108, which describes and illustrates the various Monitor control systems used in connection with newspaper and magazine printing plants and paper-calendering machines.

ELECTRIC MOTORS.—"Master Quality with Service" is the title of a folder issued by the Master Electric Company, Dayton, Ohio, which describes and illustrates its three types of motors, "RA," "DM" and "PA," for single-phase, direct-current and polyphase service respectively.

UNIT CONTROL.—Bulletin No. 103-29-B issued by Charles Cory & Son, Inc., 183-7 Varick Street, New York City, describes and illustrates the "Cory-Recony" standardized unit control for the motor operation of valves. An illustration showing an installation of a dry-dock control-type benchboard equipped with thirty-six valve-opening indicators is included. The company is also distributing bulletin No. 201-29-A, covering the Cory seamless metal hose.

POWER FACTOR.—"Fifty Questions and Answers About Power Factor" is the title of a booklet issued by the Wagner Electric Corporation, St. Louis. This catechism presents the practical aspects of the power-factor problem in a simple and direct manner. It is intended to prove useful to those who are called upon to find simple language in which to explain power factor to others, and also to those who wish to know something about it but lack time for detailed study of the subject.

CIRCUIT BREAKERS.—"Should There Be a Law to Make a Man Save Money?" is the title of a booklet issued by the Cutter Company, Philadelphia, calling attention to the use of its "U-Re-Lites" (circuit breakers) for eliminating fuse blow-outs, etc.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The construction of an automobile service, repair and garage building at 1165 Massachusetts Avenue, to cost about $50,000, is under consideration by the Edison Electric Illuminating Company of Boston. Bigelow & Wadsworth, 3 Hamilton Place, are architects.

SOUTH NORWALK, CONN.—The Department of Electricity and Water contemplates erecting a new three-wire, pole feeder line to the factory district this year. M. G. Irwin is superintendent of Electric Department.

WATERTOWN, CONN.—Plans have been prepared by Fletcher-Thompson, Inc., 542 Fairfield Avenue, Bridgeport, for an addition to the power plant, with radio brick stack, of the Watertown Manufacturing Company, to cost about $75,000.

Middle Atlantic States

ALBANY, N. Y.—Plans are under consideration by the City Council for extensions to the ornamental lighting system as follows: On Western Avenue from Manning Avenue west to the city line; on Ten Broeck Street from Clinton Avenue to Lexington Avenue, and on Morton Avenue from Clinton Street to Delaware Avenue.

BRASHER FALLS, N. Y.—The property of the Brasher Milling & Lighting Company has been acquired by the Malone (N. Y.) Light & Power Company.

BROOKLYN, N. Y.—Plans for the proposed Wallabout market on B Street, to cost about $5,000,000, include a power plant to cost about $325,000. The Department of Plant and Structures, Municipal Building, New York, is in charge.

BROOKLYN, N. Y. — Extensions and improvements contemplated by the Brooklyn Edison Company, Inc., during 1925 are to include the installation of 57,600 kw. in power transformers, construction of 30 miles of 27,600-volt, three-phase, 60-cycle transmission lines and 60 miles of 2,400/4,150-volt distribution feeder extension. E. W. Kells is secretary.

BUFFALO, N. Y.—The installation of an ornamental lighting system on Linwood Avenue, to cost about $25,000, is under consideration.

BUFFALO, N. Y.—The Stephen-Stewart Grain Corporation, Buffalo, plans to build a large power plant in connection with a grain elevator to be erected on the Hamburg Turnpike, at a cost of about $800,000, for which general construction contract has been awarded.

CHERRY CREEK, N. Y.—E. J. Ballinger, Sherman, is planning to build a power plant in connection with a proposed local milk condensory plant, to cost about $50,000.

ROCHESTER, N. Y.—The Rochester Gas & Electric Corporation plans extension of the lighting system from Irondequoit from Summerville to White City, along the Lake front, and in Washington Avenue in White City in the near future.

ROCHESTER, N. Y.—Arrangements, it is reported, are being made by the Board of Supervisors with the Rochester Gas & Electric Corporation for the installation of an ornamental lighting system along the highway from Rochester to Gates, to cost about $40,000.

TAYLORVILLE, N. Y.—The Northern New York Utilities, Inc., Watertown, plans to build an automatic hydroelectric plant on the Beaver River at Soft Maple, near Taylorville, with initial output of 21,000 hp. The project will include a transmission line.

TOTTENVILLE, N. Y.—Electric power equipment will be installed in the proposed local industrial alcohol manufacturing plant to be built by the Lake Island Refining Corporation, 25 West Forty-third Street, New York, to cost about $600,000. Ophuls & Hill, 112 West Forty-second Street, New York, are engineers.

UTICA, N. Y.—The Adirondack Power & Light Corporation, Schenectady, has applied for permission to erect a high-tension transmission line from Utica to Oneida.

TRENTON, N. J.—Bids will be received at the State House, Trenton by Guilbert & Betelle, architects, Chamber of Commerce Building, Newark, until July 6, for alterations and extensions to the power plant at the State Normal School, Trenton, consisting of a new coal bin at the power house, transforming the boiler plant from an oil-burning to a coal-burning system, grates and blowers, brick chimney and breeching and piping alterations.

TRENTON JUNCTION. N. J.—Bids will will be received at the State House, Trenton, by Guilbert & Betelle, Architects, Chamber of Commerce Building, Newark, until July 6, for extensions and improvements in the power plant at the New Jersey School for the Deaf here.

JOHNSTOWN, PA. — The Penn Public Service Corporation, which is erecting two 33,000-volt transmission circuits from the Union City substation to Erie and Warren, plans to start work soon on the extension of its 110,000-volt transmission line from Union City to Erie. Other extensions are contemplated.

TAMAQUA, PA. — Arrangements have been made by the City Council with the Pennsylvania Power & Light Company for the installation of an ornamental lighting system in the business district, to cost about $15,000.

PRINCE FREDERICK, MD.—The Public Service Commission has granted Thomas O. Tongue, permission to build an electric plant to serve electricity here.

PARKERSBURG, W. VA.—The Penn Metal Company, 675 Concord Avenue, Cambridge, Mass., plans to install a power house at its proposed local metal works, to cost about $100,000. Other plant units will be erected later at a cost of about $850,000.

RONCEVERTE, W. VA.—The date for receiving bids for improvements to waterworks has been extended from June 29 to July 9. H. K. Bell, Hernando Building, Lexington, Ky., is engineer.

SHEPARDSTOWN, W. VA. — The City Council is considering the installation of an ornamental lighting system in the business district.

SPENCER, W. VA.—The installation of an ornamental lighting system, to cost about $10,000, is under consideration by the City Council.

WASHINGTON, D. C. — Bids will be received by the General Purchasing Officer, Panama Canal, Washington, until July 15, for a generator, compensator, 100 telephone cords, etc. (Panama Circular 1681.)

WASHINGTON, D. C. — Bids will be received by the Post Office Department, Washington, until July 6, for motors for pick-up tables and motors for canceling machines as required during the fiscal year 1926.

North Central States

BARAGA, MICH.—The installation of a new 150-hp. generating unit and switchboard in the municipal electric plant is under consideration by the Village Council.

CEDAR POINT, OHIO—A power house, to cost about $125,000, is to be erected by the United States govern ent off the Cedar Point Jetty, for the purpose of furnishing electricity to operate the lighthouses in Sandusky Bay.

CHILLICOTHE, OHIO. — The Mount Logan Power Company, recently organized, has been granted a franchise to supply electricity in Chillicothe. The present plans provide for the erection of a transmission line from Coalton to Chillicothe and to hook up a loop at Logan. E. F. Bearce is interested in the company.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until July 10 for construction, complete, of the Windsor Avenue transformer house.

CLEVELAND, OHIO.—Separate bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until July 10 for auxiliary equipment for the Kirkland pumping station, turbo-generator and switchboard, for furnishing lubricating oil, and for boiler settings at Kirkland station for the Division of Water and Heat.

COLUMBUS, OHIO.—The Columbus Railway, Power & Light Company contemplates the construction of a new steam-driven generating station of 15,000 kw. capacity during 1925. C. C. Slater is vice-president and general manager.

CONNEAUT, OHIO.—The Pennsylvania-Ohio Light & Power Company, Youngstown, is negotiating for the purchase of the municipal electric plant. If acquired, it plans to extend its transmission lines to this section.

LORAIN, OHIO. — The Lorain County Telephone Company plans to place all its telephone lines throughout the city in underground conduits, at a cost of about $250,000.

YOUNGSTOWN, OHIO.—The City Council has entered into a ten-year contract with the Pennsylvania-Ohio Power & Light Company for lighting the streets of the city. Under the terms of the contract an ornamental lighting system will be installed on West Federal Street, Market and Mahoning Streets.

COVINGTON, KY.—Bids will be received by the Dixie Highway Water Company, Coppin Building, Covington, until July 13 for construction of a pumping station, furnishing and installing pumping and auxiliary machinery, etc.

ROCKVILLE, IND. — Plans are under way by the board of trustees of the Indiana State Sanitorium for the erection of a power plant at the institution, to cost about $45,000. Charles Brossman, Merchants' Bank Building, Indianapolis, is engineer.

CHICAGO, ILL.—Electric power equipment will be installed in the factory to be erected at 1901-15 South Clybourn Avenue by the Commercial Parlor Frame Company, to cost about $650,000. Edward H. Nordlei, 4727 North Maplewood Avenue, is architect.

HOMER, ILL. — The Homer Electric Light & Power Company has been granted permission to erect service lines in the Dewey, Fisher, Foosland, Bellflower and adjacent communities.

AMBERG, WIS.—The proposal to install a street-lighting system in Amberg has been approved by the voters.

BELOIT, WIS.—Plans have been completed by the Beloit Water, Gas & Electric Company for an addition to its power house to provide space for the installation of a 1,000-hp. generating unit.

BOSCOBEL, WIS.—A franchise has been granted by the City Council to C. C. Kinzie, Beloit, to supply electricity in Boscobel. Mr. Kinzie proposes to install a plant in the factory of the Boscobel Table Company.

CLINTONVILLE, WIS.—The Wisconsin Traction, Light & Power Company, Appleton, has secured a contract to supply energy to operate the municipal electric plant. To furnish this service the company will erect transmission lines connecting Clintonville with New London and also with Shawano.

GILMAN, WIS.—The proposal to issue $15,000 in bonds for the erection of a transmission line from Thorpe to Gilman, 22 miles long, to be built by the Northern States Power Company, will be submitted to the voters.

GREEN BAY, WIS. — The Wisconsin Public Service Corporation plans to extend its transmission line to furnish service to residents in Big Suamico, providing sufficient business is guaranteed to warrant the expenditure.

HUDSON, WIS. — A permit has been granted the Willow River Power Company to construct a dam and hydro-electric plant on the Willow River in St. Croix County.

RACINE, WIS.—The Wisconsin Gas & Electric Company is considering extending its steel-tower transmission line from Racine to a point near Kenosha.

YUBA, WIS.—Robert Novy, who has acquired the "old mill" property, plans to install an electric plant to furnish electricity in the village and surrounding territory. The work includes rebuilding the dam.

CANNON FALLS, MINN.—Bids will be received by the City Council until July 6 for the installation of an ornamental lighting system in the business district.

ROCHESTER, MINN.—Extensions to the municipal electric plant by the Public Utility Board during 1925 include the installation of a 2,000-kw. General Electric turbine and a Westinghouse condenser of 4,500-sq.ft. capacity. C. G. Hadley is general superintendent.

DECORAH, IOWA. — The Interstate Power Company has been authorized to erect a transmission line in Clayton and Dubuque Counties in the Dubuque section, and also a line in Winnebago County around Deland.

DES MOINES, IOWA.—Permission has been granted to the Des Moines Electric Light Company to erect a high-tension transmission line in Mahaska County to serve Oskaloosa, Beacon and Givin.

PETERSON, IOWA.—Plans are under way by the Western Iowa Power Company to rebuild its hydro-electric plant at Linn Grove, recently destroyed by fire.

WEST UNION, IOWA.—A franchise has been granted to the Northeastern Power Company, Clermont, to erect transmission lines in Floyd, Howard and Mitchell Counties, centering in Orchard and Elma.

LINN, MO.—Permission has been granted by the Public Service Commission to B. P. Eyer and S. W. Henderson to construct and operate an electric light system in Linn.

ST. LOUIS, MO.—The Board of Estimate and Apportionment has approved a bill appropriating $2,000,000 for a new street-lighting system, of which $400,000 will be used in the downtown district, $1,350,000 for two districts in north and south St. Louis, and $250,000 for lighting equipment on reconstructed streets.

BEAULAH, N. D.—Plans have been prepared by the Hughes & Deiters Company, Dickinson, for the construction of a new power plant in Beaulah.

DOYON, N. D.—The Lakota (N. D.) Light & Power Company plans to erect a transmission line from Lakota to Doyon, via Beullett.

FAIRBURY, NEB. — The proposal to issue $11,000 in bonds for improvements and extensions in the municipal electric plant has been defeated.

STICKNEY, NEB. — The local electric plant, owned by C. H. Nelson, has been acquired by the Dakota Public Service, a subsidiary of the McGraw Company, Sioux City, Iowa. Extensions and improvements are contemplated by the new owners, including a new engine and the erection of a high-tension transmission line from Plankinton.

STERLING, KAN.—Work will soon begin on the construction of a power plant at Sterling College, to supply service at the institution. Thomas W. Williamson & Company, Central National Bank Building, Topeka, are architects.

Southern States

BATTLEBORO, N. C.—The Town Council has issued $10,000 in bonds, the proceeds to be used for the installation of a new lighting system.

CLARKTON, N. C.—The City Commissioners have arranged a bond issue of $9,000 for the installation of a municipal light and power system.

ELIZABETHTOWN, N. C. — The City Council is disposing of a bond issue of $9,000, the proceeds to be used for improvements to the municipal electric light system.

HAMILTON, N. C.—The Board of Commissioners has issued $15,000 in bonds, the proceeds to be used for the installation of a lighting system.

SUMTER, S. C. — The Yadkin River Power Company has submitted a proposal to the City Council offering to purchase the municipal electric plant.

WESTMINSTER, S. C.—The Municipal Electric Light Department is planning to erect a three-phase, 2,300-volt transmission line, 5 miles long, into the rural section for light and power service. W. F. Crenshaw is superintendent.

WEST PALM BEACH, FLA.—The Southern Utilities Company, Palatka, plans to erect a 23,000-volt transmission line from Miami to West Palm Beach.

PARIS, TENN.—The installation of additional equipment at the municipal electric plant is under consideration.

BIRMINGHAM, ALA.—Application has been filed with the Federal Power Commission by the Alabama Power Company, Birmingham, for a license to build a hydro-electric plant at Lock 18, on the Coosa River, 15 miles above Montgomery. The plans provide for an initial installation of 72,000 hp., to cost about $13,500,000, and for an ultimate installation of 175,000 hp., consisting of five 35,000-hp. units.

LEACHVILLE, ARK. — Plans for the proposed cotton-compressing plant to be erected by the Buffalo Island Compress Company, to cost about $100,000, include a power plant.

LOWELL, ARK.—The City Council has contracted with the Southwest Power Company to install a street-lighting system on a number of thoroughfares.

ALEXANDRIA, LA. — The Louisiana Gravity Canal Company contemplates the construction of a hydro-electric plant in connection with an irrigation project for about 300,000 acres of rice lands, to cost about $6,000,000.

ASHER, OKLA.—Preliminary plans are being prepared for building an electric distributing system and a transmission line from Asher to Ada, to cost about $30,000.

BERNICE, OKLA.—Surveys are being made by the Public Service Company of Oklahoma, Tulsa, for a proposed hydro-electric plant on the Grand River, near Bernice, to cost about $1,750,000, with steel tower transmission line.

BESSIE, OKLA.—Plans are under consideration for installing an electric system in Bessie, to include a substation, distribution and electric transmission line from Clinton, a distance of 12 miles. The cost is estimated at $25,000.

BUTLER, OKLA.—A contract has been awarded to the Inland Utilities Company, Elk City, to install an electric lighting system in Butler, at $10,000. The work will consist of a transmission line and distribution system. John D. Bomford, Elk City, is engineer.

ENID, OKLA.—The Oklahoma Laundry Company plans to install a Diesel-engine-driven power plant, to cost about $30,000.

OKEMAH, OKLA.—Bonds to the amount of $200,000 have been voted for water-works improvements, including motor-driven pumping equipment, distribution mains, etc. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

OKLAHOMA CITY, OKLA.—Plans are under way by the Southwestern Light & Power Company for the erection of 54 miles of high-tension transmission lines, which include 7½ miles from Tipton to Headrick, 28½ miles from Temple to Grandfield, 10½ miles from Temple to Hastings, 10 miles from Hastings to Waurika and 7½ miles from Grandfield to the city waterworks. The power plant in Waurika has been purchased by the company contingent upon a franchise being awarded the company.

GOREE, TEX. — The Council has contracted with the West Texas Utilities Company, Abilene, for the installation of an ornamental street-lighting system in the business district.

Pacific and Mountain States

PORT ANGELES, WASH.—Permission has been granted the Northwestern Power & Manufacturing Company to appropriate 600 sec.-ft. of water of the Elwha River and to store 15,000 acre-ft. of water in Glines' reservoir. The plans provide for a development of 10,000 hp., to cost about $800,000.

TACOMA, WASH.—The City Council has adopted a resolution providing for the installation of ornamental lamps on Park Avenue from Thirty-eighth to Sixty-fourth Street.

ALHAMBRA, CAL.—The City Council has approved an ordinance for the installation of an ornamental lighting system on El Molino Street.

LANKERSHIM, CAL.—Plans are being considered by the Power and Light Bureau, Department of Public Service of Los Angeles, for the erection of a substation in Lankershim to supply electric service in this section of San Fernando Valley. A substation will also be built at Owensmouth.

LOS ANGELES, CAL.—Plans are under way by the Bureau of Power and Light for extensions and improvements to the municipal electric system, to cost about $21,000,000. Work will begin at once on twelve new substations to cost approximately $2,500,000, which will have an initial capacity of 75,000 kva. and will transform energy from 35,000 volts to 4,400 volts. During the coming year 4 miles of 33,000-volt underground cable, 4 miles of low-voltage cable and 50 miles of 33,000-volt overhead lines will be built.

PIEDMONT, CAL.—The City Council has granted the Pacific Gas & Electric Company a permit to build a substation at Linda and Oakland Bridge Avenues, to cost about $70,000.

SACRAMENTO, CAL. — Arrangements have been completed for the erection of a 220-kv. steel-tower transmission line from Sacramento to Merced, 104 miles long, by the Great Western Power Company, San Francisco, to connect with the system of the San Joaquin Light & Power Corporation, Fresno. A carrier-current telephone system will be installed for communication service. The cost of the project including substations is estimated at about $2,750,000.

SAN DIEGO, CAL. — Bids have been asked by the City Council for the installation of ornamental lighting systems on portions of B, C, First, Second, Columbia, Union and Front Streets. F. A. Rhodes is city engineer.

SAN FRANCISCO, CAL.—The Board of Supervisors has approved an ordinance authorizing the signing of the contract for the sale of Hetch Hetchy power to the Pacific Gas & Electric Company.

WATSONVILLE, CAL.—The installation of an ornamental lighting system in the business district is under consideration. City Engineer Kitchen is in charge.

WATSONVILLE, CAL.—Electric power equipment will be installed in the cold-storage and refrigerating plant to be built by the Pajaro Valley Cold Storage Company, to cost about $175,000

SALT LAKE CITY, UTAH.—The Griffin Wheel Company, 410 North Michigan Avenue, Chicago, plans to build a local plant, including a cupola, a power house, foundry and machine shop, under one roof.

MESA, ARIZ.—Bids will be received by the City Council until July 11 for the purchase of a bond issue of $98,500, the proceeds to be used for extensions and betterments to the municipal electric plant. The Weiland Engineering Company, Thatcher Building, Pueblo, Col., is engineer.

ISMAY, MONT.—Bonds to the amount of $9,000 have been issued, the proceeds to be used for the installation of a municipal lighting system.

COLORADO SPRINGS, COL.—At a foreclosure sale of the property of the Colorado Springs Light, Heat & Power Company the plant and equipment was purchased by the representatives of the bondholders. When the sale is sanctioned the electrical division will be turned over to the city.

JULESBURG, COL.—The Great Western Sugar Company, Ladysmith, Wis., contemplates the construction of a power plant at its proposed beet-sugar mill in this section, to cost about $1,200,000.

Canada

GRAND FALLS, N. B. — Negotiations have been completed whereby the water-power rights of the Grand Falls Company, at Grand Falls, on the St. John River, which is two-thirds owned by the International Paper Company, have been transferred to the Province of New Brunswick. The province, which has been granted permission by the International Joint Commission to develop the water power, plans to carry out a $9,000,000 development, including a 50,000-hp. hydro-electric plant at Grand Falls. Under the terms of the agreement the International Paper Company will take 14,000 hp., which it may eventually use in a new mill at this point. The company has also contracted for 2,000 hp. additional to be used at the Van Buren mill in the State of Maine.

ST. JOHN, N. B. — Tenders are being asked by the New Brunswick Hydro-Electric Commission for the construction of a tunnel and power house at Grand Falls.

CAMPBELLFORD, ONT.—Plans are being considered by the Canadian Paperboard Company for a hydro-electric development in connection with its plant, to include power house, pipe line, turbines, generators, etc., to cost about $150,000. Kerry & Chace, Ltd., Confederation Life Building, Toronto, are engineers.

COATICOOK, QUE.—The town of Coaticook is taking over a number of power plants in this district, to be operated in connection with the municipal electric system.

QUEBEC, QUE.—The Quebec Southern Power Corporation, which recently acquired the property of the La Compagnie Electrique des Laurentides, Ltd., is planning to make extensive additions to the system, which will enable it to serve more than thirty towns in the Laurentian district.

Electrical Patents

Announced by U. S. Patent Office

(Issued June 2, 1925)

1,539,903. ELIMINATION OF INTERFERENCE IN CARRIER SYSTEMS; L. M. Ilgenfritz, Orange, N. J. App. filed May 21, 1924.

1,539,920. SIGNALING SYSTEM; D. M. Taggart, Seattle, Wash. App. filed Dec. 12, 1922. For telephone exchange.

1,539,925. MULTI-OFFICE TELEPHONE SYSTEM; B. D. Willis, Oak Park, Ill. App. filed July 21, 1920.

1,539,928. REACTANCE; D. J. Angus, Indianapolis, Ind. App. filed Sept. 2, 1922.

1,539,949. HINGED-OVEN ELECTRIC BURNER; R. H. MacInnes, Hamilton, Ontario, Canada. App. filed Sept. 12, 1924.

1,539,962. MEANS FOR CONNECTING BIMETALLIC CONDUCTORS; H. J. Seufert, Brooklyn, N. Y. App. filed March 27, 1923.

1,539,979. ALARM DEVICE; A. S. Waddington, London, England. App. filed Aug. 16, 1924.

1,539,991. PRESSURE-RESPONSIVE SWITCH FOR GAS-FLOW ALARMS; H. Cappellanti, Morgantown, W. Va. App. filed Feb. 13, 1924.

1,540,000. CARTRIDGE FUSE, FERRULE TYPE, FOR REMOVABLE FUSE ELEMENTS; J. B. Glowacki, Chicago, Ill. App. filed Feb. 1, 1922.

1,540,007. REFLECTOR HEATER; C. W. Homeyer, Cleveland, Ohio. App. filed Sept. 15, 1924.

1,540,008. ELECTRICAL CONNECTOR; C. L. Hopkins, River Forest, Ill. App. filed June 2, 1922. Swivel attachment plug caps for use with standard separable attachment plugs.

1,540,033. MACHINE SWITCHING TELEPHONE EXCHANGE SYSTEM; L. Polinkowsky, London, England. App. filed Oct. 18, 1918.

1,540,034. TELEPHONE EXCHANGE LINE SWITCH; C. D. Richard, New Brighton, N. Y. App. filed Sept. 3, 1920.

1,540,038. ELECTRIC MOTOR; M. H. Spielman, Cleveland, Ohio. App. filed July 18, 1921. Fractional-horsepower type.

1,540,043. TELEPHONE SYSTEM; H. S. Turner, Brooklyn, N. Y. App. filed Feb. 27, 1915. Connections established by means of cord and trunk circuits.

1,540,050. ELECTRICAL RECEPTACLE; R. B. Benjamin, Chicago, Ill. App. filed Dec. 10, 1919.

1,540,051. PLUG CLUSTER; R. B. Benjamin, Chicago, Ill. App. filed Feb. 6, 1920.

1,540,052. PANELBOARD; R. B. Benjamin, Chicago, Ill. App. filed June 14, 1920. Standard and interchangeable units.

1,540,053. IMPULSE RECEIVING CIRCUIT; P. H. Burton, Floral Park, N. Y. App. filed April 26, 1923. For telephone-exchange system.

1,540,054. TELEPHONE-EXCHANGE SYSTEM; W. W. Carpenter, Queens, N. Y. App. filed Sept. 21, 1923.

1,540,059. SELECTIVE SWITCH; R. D. Conway, Bernardsville, N. J. App. filed Dec. 5, 1921. Cross-bar switches used for the selection and connection of balancing networks in repeating circuits as in telephone circuits.

1,540,060. TELEPHONE CALL DISTRIBUTION SYSTEM; G. Deakin, Antwerp, Belgium. App. filed Nov. 29, 1922.

1,540,061, 1,540,062. TELEPHONE SYSTEM; A. H. Dyson, Chicago, Ill. App. filed July 20, 1905. Automatic.

1,540,063. SWITCHING MECHANISM; O. F. Forsberg, Yonkers, N. Y. App. filed Dec. 28, 1922. For automatic telephone exchange.

1,540,064. TELEPHONE-EXCHANGE SYSTEM; C. B. Fowler, New York, N. Y. App. filed Sept. 16, 1920. Interconnection system between manual and automatic exchanges.

1,540,066. TELEPHONE-EXCHANGE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed Oct. 25, 1920. Private branch exchange.

1,540,080. LINE BAR FOR CROSS-BAR LINE SWITCHES; A. C. Magrath, Brooklyn, N. Y. App. filed Oct. 16, 1920. Adapted for use in automatic telephone exchanges.

1,540,087. TELEPHONE SYSTEM; W. Pinell, Berlin-Siemensstadt, Germany. App. filed April 5, 1922. Automatic or semi-automatic system.

1,540,097. ELECTRIC SWITCH; F. Balint, Bridgeport, Conn. App. filed March 17, 1924. For operating a series of signaling elements in succession.

1,540,118. CARTRIDGE FUSE, KNIFE BLADE TYPE, FOR REMOVABLE FUSE ELEMENTS; J. B. Glowacki, Chicago, Ill. App. filed Feb. 1, 1922.

1,540,119. RENEWABLE FUSE ELEMENT; J. B. Glowacki, Chicago, Ill. App. filed March 9, 1922.

1,540,121. SYSTEM OF TELEDYNAMIC CONTROL; J. H. Hammond, Jr., Gloucester, Mass. App. filed March 21, 1913. For the operation of steering gear and other mechanisms as on a torpedo.

1,540,159. MAKE-BUSY ARRANGEMENT FOR SECONDARY TRUNKING SWITCHES; J. I. Bellamy, Chicago, Ill. App. filed Aug. 25, 1922.

1,540,174. CLUSTER PLUG; C. S. Mallett, Toronto, Ontario, Canada. App. filed Nov. 26, 1921.

1,540,178. ELECTRICAL COOKING APPARATUS; B. Moegling, Berlin, Germany. App. filed Aug. 29, 1921.

1,540,236. COMBINED STATIONARY TRANSFORMER AND CONVERTER; H. M. Abernethy and H. D. Abernethy, Cleveland, Ohio. App. filed Sept. 16, 1919.

1,540,237. ELECTRIC POWER PLANT SYSTEM; V. G. Apple, Dayton, Ohio. App. filed Sept. 15, 1919.

1,540,272. CENTRIFUGAL SPEED REGULATOR; F. W. Merrill, East Orange, N. J. App. filed Jan. 19, 1922.

1,540,310. TESTING SYSTEM; L. J. Bowne, Howard Beach, N. Y. App. filed March 10, 1923. For telephone line circuit.

1,540,313. PRINTING TELEGRAPHY; M. P. Chapman, White Plains, N. Y. App. filed Nov. 13, 1920.

1,540,315. PRESSURE RESPONSIVE MAKE-AND-BREAK-DEVICE; W. F. Clark, Warren, Pa. App. filed April 2, 1921.

1,540,317. METHOD OF AND APPARATUS FOR RECORDING SOUND; E. B. Craft, Hackensack, N. J., and E. H. Colpitts, East Orange, N. J. App. filed Nov. 28, 1919.

1,540,318. PICTURE-TRANSMITTING APPARATUS; L. A. Dunajeff, New York, N. Y. App. filed Oct. 24, 1921.

1,540,328. CONTACT TERMINAL; A. Haddock, East Orange, N. J. App. filed Sept. 20, 1921.

1,540,330. ELECTRICAL RECEPTACLE; P. Hartmann, Brooklyn, N. Y. App. filed Sept. 30, 1922.

1,540,355. VACUUM-TUBE TESTING DEVICE; R. C. Mathes, New York, N. Y. App. filed Oct. 20, 1919.

1,540,377. PULL-SWITCH SOCKET; W. E. Warner, Berwyn, Ill. App. filed April 25, 1921.

1,540,387. TELEGRAPH RECEIVING APPARATUS; A. Clausing, Berlin-Charlottenburg, Germany. App. filed Jan. 25, 1924.

1,540,401. VACUUM OVEN; M. J. Kelly, New York, N. Y. App. filed Aug. 24. 1920.

1,540,403. MUNICIPAL SERVICE POST; O. D. Kleinsteuber, Milwaukee, Wis. App. filed Nov. 9, 1922. Combined fire-alarm box, telephone, etc.

1,540,418. AUTOMATIC TELEPHONE TRUNKING SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Aug. 19, 1918.

1,540,419, 1,540,420. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Dec. 28, 1920, and May 28, 1921.

1,540,421. TELEPHONE CIRCUITS; W. T. Powell, Rochester, N. Y. App. filed June 5, 1924.

1,540,505. INSULATOR MOUNTING; E. O. Sessions, Chicago, Ill. App. filed June 13, 1919.

1,540,532. BATTERY SEPARATOR; O. W. Brown and C. O. Henke, Bloomington, Ind. App. filed Oct. 10, 1923.

1,540,578. MEANS FOR PRODUCING OSCILLATIONS; H. C. Thompson, Schenectady, N. Y. App. filed July 1, 1921.

1,540,585. ELECTRICAL STETHOSCOPE; R. B. Abbott, Lafayette, Ind. App. filed Oct. 27, 1922.

1,540,596. ELECTRIC SWITCH; G. A. Burnham, Saugus, Mass. App. filed March 31, 1919. Oil-immersed of relatively large current-carrying capacity.

1,540,628. AUTOMATIC TEMPERATURE CONTROL FOR BREAD TOASTERS; F. E. Hurxthal, Salem, Ohio. App. filed Dec. 1, 1924.

1,540,648. HEATING DEVICE FOR OIL WELLS; R. S. Pershing, Fort Worth, Tex. App. filed Oct. 3, 1922.

1,540,652. TROLLEY WHEEL; F. W. Sakon, Windber, Pa. App. filed Nov. 3, 1924.

1,540,655. ELECTRICALLY OPERATED CRANE, HOIST AND THE LIKE; W. H. Scott and John Bentley, Norwich, England. App. filed May 4, 1921. In which the braking is effected rheostatically.

1,540,669. FURNACE REFRACTORY; M. Unger, Pittsfield, Mass. App. filed May 16, 1923.

1,540,679. PROTECTIVE INSTALLATION FOR ELECTRIC CIRCUITS; C. E. Bennett, Decatur, Ga. App. filed May 9, 1922. For low-voltage distribution circuits.

Financial and Corporate

Market Generally Firm

General Gas & Electric Jumps as Plan Is Proposed—Trading Active in Some Stocks

THE market in power and light stocks has come to be very much like the general market in that generalizations nowadays do not have so much significance as formerly. Utility stocks in the week under review, for example, did not move uniformly in any direction. Weak spots were to be found in certain divisions and strong spots in others. Of course, the generally sound position of business and the continued ease in money rates are factors that bear upon the whole market for power and light issues, but the outstanding movements are prompted by special considerations.

General Gas & Electric Corporation improved its position by about twenty-five points, for example, as a result of the proposal to recapitalize the present utility in such a way as to remove the participating feature from future issues of preferred stock and to get rid of the present funded debt. Power Corporation of New York is another issue that has come in for a great deal of attention of late on account of the prospect that this utility will feature in an up-state merger. It is reported that a price well above the present market has been offered for the stock. Havana Electric on the New York Stock Exchange again has come to life around 180 as rumors persist, despite denials, that the Cuban property is likely soon to pass to the control of another group.

One of the more interesting features of the market recently is the demand for electric refrigeration stocks as a result of the movement in the power and light industry to install electric refrigerators. Kelvinator for several weeks has been strong and active, but the stock that has attracted most attention in this group recently is that of the Serv-el Corporation, which last week moved from 14 to 20.

Standard Power & Light Stock to Be Exchanged

In a letter to holders of trust receipts for stock of the Standard Power & Light Corporation (of Maryland), H. M. Byllesby & Company gave the terms for exchanging such receipts for stock of the new corporation, the Standard Power & Light Company (of Delaware), which, as already announced, has been organized to purchase a majority of the voting shares of the Pittsburgh Utilities Corporation. In order to give holders of trust receipts the benefit of direct ownership in the Standard Power & Light Corporation (of Delaware) there will be issued to them for each share of cumulative preferred stock of Standard Power & Light Corporation (of Maryland) an exactly equivalent share of cumulative preferred stock (entitled to annual dividend at the rate of $7 per share) in the Delaware corporation, and for each ten shares of common stock of the Maryland corporation there will be issued to them eleven shares of the class A common stock of the Delaware corporation.

The Standard Power & Light Corporation (of Delaware) will have outstanding on the completion of the transaction 100,000 shares of preferred stock (exchanged for the 100,000 shares of preferred stock of the Maryland corporation), and 440,000 shares of common stock (of which 30,000 voting class B shares will be controlled by the management) in lieu of 400,000 shares of common stock of the Maryland corporation, of which 110,000 shares will be exchanged for the 100,000 shares represented by the trust receipts.

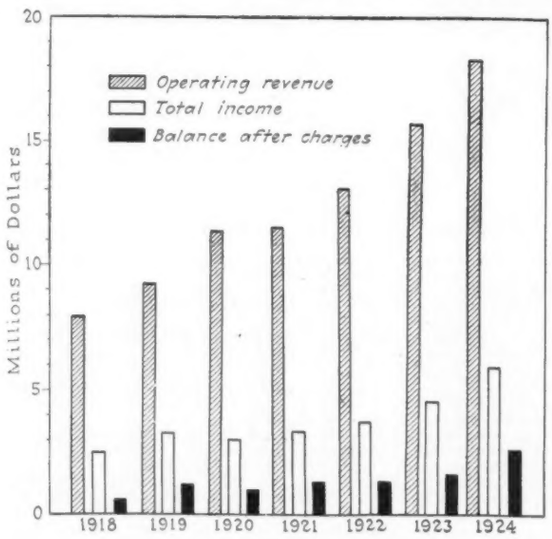
General Gas & Electric Recapitalizes

Corporation Plans to Retire Its Bonded Debt and to Set Up Instead a Capital Structure Under Which It Can Finance More Advantageously

BY PAUL WILLARD GARRETT

THE great growth that has come to the General Gas & Electric Corporation in the last few years, carrying its common shares from a market price of a few dollars to $175 a share, now has reached a point where the management is planning to create a new dress to replace the one that has been outgrown.

That the old capital structure is not designed to allow for the greatest and freest growth in the present circumstances must be clear to any one who reviews the steps forward that General Gas & Electric Corporation has made just within the last five years. Gross revenues have mounted from $7,958,919 in 1918, for example, to upward of $20,000,000 for the last twelve months reported. Property assets alone now exceed $100,000,000. Subsidiaries of this W. S. Barstow & Company enterprise may be found in New York, South Carolina, North Carolina and Florida, but the principal operating properties belong in the well-known Pennsylvania-New Jersey Power System of the General Gas & Electric Corporation. Already a superpower system has been built that connects such places as Dover, Hackettstown and Lebanon, N. J., with Easton, Reading, Lebanon, York and Hanover, Pa. These connections are stimulating growth, and others still in the process of construction are certain to stimulate further growth. That the General Gas & Electric Corporation will need more and more money as the years pass with which to expand is as obvious as that it will want to obtain these funds on a basis most advantageous to the organization.



GENERAL GAS & ELECTRIC EARNINGS SHOW MARKED INCREASE

To put the utility in a position to finance its future needs on the best terms possible, the management is now proposing to create a new Delaware corporation to replace the present Maine corporation, at the same time making certain modifications in the structure. As things stand now, General Gas & Electric Corporation's preferred stocks all contain provisions that obligate the corporation in a way that is not desirable so far as future issues of preferred stock are concerned. The cumulative class A preferred stock, for example, as well as the cumulative class B preferred, have the right not only to dividends up to $8 and $7 a share respectively ahead of other stock issues, but in addition have the right to participate in all dividends after a certain distribution is made to the common shares. The management does not, of course, propose to take from present holders of the class A and B stocks any advantages that they may enjoy by virtue of this par-

ticipation, but what it does want is to create a structure under which in the future it may issue preferred shares that do not carry the participation feature. Thus the old eight-dollar participating preferred A stock will be exchanged share for share for new non-participating preferred stock. In addition, and to enable old preferred stockholders to preserve their same relative claim to dividend participation, four participating certificates will be issued to each share of the old class A and B participating preferred stock of the company.

The General Gas & Electric Corporation as now organized has four classes of stock, and under the new plan they will be treated as follows: (1) Each share of the present cumulative participating eight-dollar preferred stock, class A, will be exchanged for a new share of non-participating eight-dollar cumulative preferred stock and for four participating certificates. (2) Each share likewise of the seven-dollar participating preferred stock, class B, will be exchanged for a new share of non-participating preferred stock of the same rate and four participating certificates. (3) Each share of the old non-cumulative convertible six-dollar preferred stock will be exchanged for four shares of new dollar-and-a-half class A common stock entitled to participate in further dividends after the class B common stock has received $1.50 a share as dividends in any year. (4) Each share of old common will be exchanged for four shares of new class B common.

By the plan to be submitted to stockholders the General Gas & Electric Corporation will free itself from funded debt and preserve to old preferred stockholders their same relative status, but it evolves from the change a new capital structure that places the utility in a much stronger financial position than ever before.

New Capital Issues During June

Electric Light and Power Companies Float New Securities to the Amount of $96,495,500, Bringing Six Months' Total to $597,943,500

DURING the month of June the electric light and power companies made new offerings of stocks, bonds and notes to the amount of $96,495,500, as compared with $106,987,500 recorded for June a year ago. This amount brings the total for the half-year period up to $597,943,500, an increase of more than $140,000,000 over the corresponding period of 1924, when electric light and power utilities raised $457,507,200 by the sale of securities. These figures represent public sales and do not include securities sold locally.

Twenty-eight utilities participated in June's financing, which was predominantly of a long-term nature. The largest individual piece of financing was done by the Engineers' Public Service Company, the organization formed by Stone & Webster, Inc., and Associates—an issue of 200,000 shares of preferred stock in the form of allotment certificates offered at $100 per share, one-half being payable at date of purchase and the remainder subject to call by the company, but no call to be made before January 1, 1926. All the allotment certificates were sold within a few hours after the public offering. The average yield fell sharply from 6.42 per cent in May to 6.00 per cent in June. Attention is called to the low yield realized from the first mortgage gold bonds of the Consolidated Gas, Electric Light & Power Company of Baltimore offered at 100½.

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN JUNE

Name of Company	Amount of Issue	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Detroit Edison Co	$8,000,000	30	General and refunding mortgage gold bonds, series B	Construction	5	99½	5.03
Consolidated Gas, Electric Light & Power Co. of Baltimore	1,000,000	..	Cumulative preferred stock	To reimburse company for cost of additions and extensions and other capital expenditures	6	100½	5.97
.....	9,000,000	40	First refunding mortgage sinking-fund gold bonds, series F	.....	5	100½	4.97
Great Western Power Co. of Calif.	6,300,000	30	First and refunding mortgage sinking-fund gold bonds, series D	Refunding	5½	99	5.57
nterstate Power Co	2,850,000	..	Preferred stock	Extensions	7	95	7.37
Kansas Power & Light Co	2,100,000	30	First mortgage gold bonds, series A	Construction	6	100	6
Twin State Gas & Electric Co	1,900,000	20	First lien and refunding mortgage gold bonds, series A	Refunding, reimbursing treasury for refunding notes and for expenditures on additions and extensions	5½	95½	5.88
Arkansas-Missouri Power Co	800,000	28	First mortgage sinking-fund gold bonds	To pay for new properties and for additions and extensions	6	95½	6.35
.....	500,000	10	Gold debentures	.....	6½	96½	7.00
Central Illinois Public Service Co.	4,600,000	25	First mortgage and refunding gold bonds, series D	Refunding	5½	98½	5.60
New Orleans Public Service, Inc.	5,000,000	30	First and refunding mortgage gold bonds, series B	Improvements and extensions	5	95½	5.37
Otter Tail Power Co	200,000	..	Cumulative preferred stock	General corporate purposes	6	87	6.90
Sioux City Gas & Electric Co	3,000,000	..	Cumulative preferred stock	To reimburse for expenditures made for purchase of properties and for other corporate purposes	7	100	7
Illinois Power & Light Corp	5,000,000	29	First and refunding mortgage gold bonds, series B	Construction	5½	99½	5.53
Iowa Power & Light Co	2,000,000	30	First mortgage gold bonds, series A	Construction	6	101	5.93
Georgia Hydro-Electric Co	470,000	20	First mortgage sinking-fund gold bonds	Additions	6½	100	6.50
Miami City Power & Water Co. (Ariz.)	350,000	1 to 10	First mortgage serial gold bonds	.....	7	100 to 101	6 to 7
Quebec Southern Power Corp	600,000	20	First mortgage and collateral trust sinking-fund gold bonds	Additions and extensions and to provide additional working capital	6½	100	6.50
El Paso Electric Co	3,000,000	25	First mortgage gold bonds, series A	Refunding	5	95⅞	5.30
Catskill Power Corp	2,500,000	30	First mortgage gold bonds, series A	Construction	5½	95	5.85
Engineers' Public Service Co	20,000,000	..	Preferred stock	To purchase control of other utility, for working capital and for other corporate requirements	7	100	7
Central Maine Power Co	1,500,000	30	First and general mortgage good bonds... series D	.....	5	97	5.20
Metropolitan Edison Co	1,700,000	..	Preferred stock, series B	Extensions and improvements	7	100	7
Quebec Power Co	1,000,000	..	Cumulative preferred stock	General capital expenditures	7	105	6.67
Power Corporation of Canada	2,500,000	..	Cumulative first preferred stock	To acquire control in other utilities	6	100	6
Michigan Public Service Co	500,000	1	Gold notes	Additions	6	99½	6.37
Southwestern Public Service Co	3,500,000	20	First mortgage sinking-fund gold bonds series A	To retire debt and for acquisition of additional properties	6	99	6.10
National Public Service Corp	2,500,000	..	Cumulative preferred stock, series A	To acquire properties and for additional working capital	7	96	7.29
Columbus Electric & Power Co	2,000,000	29	First and refunding mortgage gold bonds, series B	Construction	5	95½	5.30
Northern New York Utilities, Inc.	2,125,500	30	First lien and refunding bonds, series E	Construction and to reimburse for additions	5	95¼	5.30
Total	$96,495,500						

Company Reports

The following statements of earnings were issued during the past week by electric light and power companies for the month of May:

Name of Company	Gross Earnings for May 1925	1924
American Gas & Electric	$3,929,533	$2,991,340
American Water Wks. & Elec.	3,252,322	3,142,275
Bangor Hydro-Electric	115,397	118,920
Binghamton Lt., Heat & Pwr	128,015	105,512
Central Illinois Light	303,452	277,984
Central Maine Power	313,865	294,635
Columbia Gas & Electric	2,705,789	1,782,403
Commonwealth Power	2,615,661	2,503,880
Consumers Power	1,615,604	1,477,673
Federal Light & Traction	499,675	438,430
Florida Public Service	76,989	62,487
Georgia Railway & Power	1,409,132	1,323,748
Knoxville Power & Light	203,059	19[illegible],687
Metropolitan Edison	676,816	647,547
Nevada-California Electric	452,730	402,345
New Bedford Gas & Edison Lt.	324,100	273,283
New Jersey Power & Light	97,980	83,610
Newport News & Hampton Ry. Gas & Elec	163,393	151,731
North Carolinas Public Service	153,275	136,010
Northern Ohio Power	941,541	844,528
Pennsylvania Edison	230,861	246,051
Philadelphia Company	4,862,165	4,728,618
Portland Electric Power	915,378	895,144
Sayre Electric	21,102	1[illegible],601
Southern Canada Power	9[illegible],713	83,841
Southern Indiana Gas & Elec.	21[illegible],461	21[illegible],971
Staten Island Edison	229,214	224,023
Tennessee Electric Power	945,083	778,691
United Gas & Electric	1,213,145	1,087,728
Washington Water Power	439,861	426,892
West Penn Co	2,068,118	2,132,869

Dividends Declared

The quarterly dividends listed below were announced during the past week by electric light and power companies and electrical manufacturing companies:

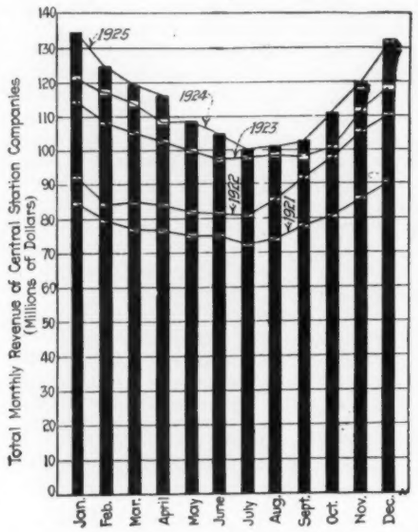
Name of Company	Per Cent	When Payable
American Electric Power, pf	1¾	Aug. 15
American Water Wks. & Elec., com.	.30	Aug. 15
American Water Wks. & Elec., 7% pf.	1¾	Aug. 15
American Water Wks. & Elec., 6% pf.	1½	Aug. 15
Appalachian Power, pf	1¾	July 15
Appalachian Power, 1st pf	1¾	Aug. 1
Arizona Power, 8% pf	2	July 1
Binghamton Lt., Ht. & Pwr., 6% pf.	1½	July 1
Binghamton Lt., Ht. & Pwr., 7% pf.	1¾	July 1
California Elec. Generating, pf	1¾	July 1
Columbia Gas & Electric, com	.65	Aug. 15
Columbia Gas & Electric, pf. A	1¾	Aug. 15
Columbia Ry., Gas & Electric, pf.	1¾	July 1
Columbus Electric & Power, com.	2½	July 1
Columbus Elec. & Pwr., 1st & 2d pf.	1¾	July 1
Commonwealth Edison	$2	Aug. 1
Commonwealth Gas & Electric, pf.	$1.50	July 15
Consumers El. Lt. & Pwr. (New Orl)	2	June 26
Eastern Texas Electric, com	$1.25	July 1
Eastern Texas Electric, pf	3½	July 1
Edison Electric (Lancaster)	3	Jun. 30
Elmira Water, Lt. & R.R., com.	1½	June 30
Elmira Water, Lt. & R.R., 1st pf.	1¾	June 30
Elmira Water, Lt. & R.R., 2d pf.	1½	June 30
Fall River-Electric	.50	July 1
Florida Public Service, pf	1¾	July 1
Georgia Lt., Pwr. & Rys., pf.	1¾	July 1
Michigan Gas & Electric, pr. lien.	1¾	July 15
Michigan Gas & Electric, pf.	1¾	July 20
National Electric Power, 7% pf.	1¾	July 1
New Jersey Power & Light, pf	1¾	July 1
New Orleans Public Service, pf	$1.75	July 1
Public Service Co. of Oklahoma, pr. l	1¾	June 30
Public Service Co. of Oklahoma, pf.	1½	June 30
Public Service Co. of Oklahoma, com	2	June 30
San Diego Cons. Gas & Elec., pf.	1¾	July 15
Sayre Electric, pf	1¾	July 15
Southern Cities Utilities, com.	.75	July 10
Southern Cities Utilities, pf.*	.58⅓	July 10
Southwestern Lt. & Pwr., com. A	$1.50	July 6
Southwestern Light & Power, pf.	$2	July 1
Worcester Electric Light	$1	June 30
Century Electric	1½	June 22
Electric Vacuum Cleaner, pf.	1¾	July 1
Ohio Brass, Class B	$3	July 15
Ohio Brass, pf	1½	July 15
Pittsburgh Transformer, pf.	2	July 1
Pittsburgh Transformer, com.	2	July 1
Wagner Electric, pf	1¾	July 1

* Monthly.

Holding Company to Increase Capitalization.—Stockholders of the Electric Power & Light Corporation have voted approval of a new financial set-up to consist of 4,020,000 shares without par value, including 800,000 shares of preferred stock, 120,000 shares of second preferred, series A; 100,000 shares of second preferred, series AA, and 3,000,000 shares of common. The corporation's acquisition of the Southern Power & Light Company was ratified during this week by the stockholders of the latter company.

Revenue Shows Substantial Gain Over Last Year

Reports received by the ELECTRICAL WORLD from central-station systems representing 76 per cent of the generator rating of the industry indicate that the total gross revenue from the sale of energy during April was $116,800,000, or a daily average of $3,893,000, an increase of 7.8 per cent over April of last year. During April the gross revenue was 3.6 per cent below the estimated normal for that month based upon the operations of the industry during the past five years.



GROSS REVENUE FOR APRIL TOTALS $116,800,000

The operating expenses during April totaled $51,750,000, a gain of 7.2 per cent over April of last year.

To Change Par of Stock.—The Newburyport (Mass.) Gas & Electric Company has been authorized by the Massachusetts Department of Public Utilities to change the par value of the stock from $100 to $25 a share.

U. G. I. Increases Stock.—Stockholders of the United Gas Improvement Company have approved the proposed increase in capital stock from 1,521,456 shares of $50 par value to 1,654,862 shares. All of the increase will be in common stock.

Stock Listed.—The board of governors of the Chicago Stock Exchange has listed 22,000 additional shares of 7 per cent prior lien stock of the Midland Utilities Company. This, with 120,000 shares listed last February, makes a total of 142,000 shares, with a par value of $14,200,000, admitted to trading on the local exchange.

Toronto System Annual Report.—The Toronto Hydro-Electric System in its fourteenth annual report shows gross income of $8,476,672 and expenses of operation amounting to $6,211,092. Kilowatt-hours sold totaled 485,708,476 as compared with 392,367,546 in 1923. The number of customers has been increased by over 9,300.

Pays 20 per Cent Dividend.—The directors of the Washington Railway & Electric Company have declared a dividend of $20 per share on the outstanding $6,500,000 common stock, par $100, on which payments have been omitted from June 1, 1919, to March 1, 1923, both inclusive.

Cities Service Completes Redemption Operation.—The plan announced early this year by the Cities Service Company for the redemption of its cash and stock scrip has been completed recently. The total redemption involved $35,000,000, of which $10,000,000 was paid in cash and $25,000,000 in stock to the holders of the dividend scrip. A substantial part of the $10,000,000 paid out by the company in redeeming its cash dividend scrip was reinvested by the company's security owners in various Cities Service securities.

American Water Works to Call Stock.—Following a special meeting of the stockholders of the American Water Works & Electric Company, Inc., held recently in Richmond, Va., at which time it was voted to retire and cancel the 100,000 shares outstanding of 6 per cent participating preferred stock, the directors of the company at a meeting held in New York City voted to call for redemption on August 24 the said stock at $105 per share. Arrangements have been made by which stockholders will be offered an opportunity to exchange their participating preferred stock on the following basis: For each share of participating preferred stock a half share of 7 per cent cumulative first preferred stock, a half share of common stock and $27 in cash, the said exchange to be made on or before July 24, 1925. The New York Stock Exchange has authorized the listing of the new first preferred and common stock as offered in exchange.

Calumet Company Files Application to Increase Capital.—The Calumet Gas & Electric Company in order to provide funds for the purchase of the Calumet Power Company seeks authority from the commission to add $3,200,000 to its capitalization. It proposes to issue $2,200,000 of its first and refunding mortgage bonds and 100,000 shares of its common stock without par value. The actual expenditure already made by the Calumet Power Company to April 30, 1925, in acquiring property and building the superpower system is set down in the petition as $1,146,861. The construction budget for the extension of the line calls for expenditure of $1,397,658. In addition to covering these expenditures, the Calumet Gas & Electric Company seeks authority to issue securities to provide funds for other additions and extensions to its property totaling $241,806 and to call and retire bonds of the Indiana Electric Utilities Company, recently acquired, which will require $194,069.

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Saturday, June 27	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	101	98	106
Appalachian Power, 7 per cent	99	92	100
Arkansas Light & Power 7 per cent	96	92	98
Asheville Power & Light 7 per cent	a100	100	101
Central Illinois Public Service 6 per cent	85	84	93
Colorado Power 7 per cent	94	93	98
Connecticut Light & Power 7 per cent	106	105	110
Consumers' Power 6 per cent	94	90	97
Dayton Power & Light 6 per cent	96	88	100
Duquesne Light 7 per cent	111	105	111¾
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	a101½	101½	103
Great Western Power 7 per cent	102	...	...
Illinois Northern Utilities 6 per cent	88	82	92
Illinois Power & Light 7 per cent	95½	92½	98
Kansas Gas & Electric 7 per cent	a101	101	103
Long Island Lighting 7 per cent	100	100	105
Minnesota Power & Light 7 per cent	a 99	99	101
Mississippi River Power 6 per cent	90	87½	92
Nebraska Power 7 per cent	a101½	101	103
Niagara Falls Power 7 per cent—25	28½	28	29
Niagara, Lockport & Ont. Power 7 per cent	109	101½	110
Northern States Power 7 per cent	99	95	100
Ohio Public Service 7 per cent	98½	97	100
Pacific Gas & Electric 6 per cent	96½	92	97
Pacific Power & Light 7 per cent	a100	100	101
‡Penn. Central Light & Power	65	60	67
Penn-Ohio Power & Light 7 per cent	94	91	100
Pennsylvania Power & Light $7—no par	a103	103	104
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	39¾	37½	45
Southern California Edison 8 per cent	125	115	122
Southern California Edison 7 per cent	107	105	107½
Southern California Edison 6 per cent	93½	90	94½
Tennessee Electric Power, 6 per cent	82	80	84
Texas Power & Light 7 per cent	a101½	101½	103
Utah Power & Light 7 per cent	a100½	100½	101½
Western States Gas & Electric 7 per cent	89	82	92
Yadkin River Power, 7 per cent	a101	101	102
Holding Companies			
American Gas & Electric 6 per cent—no par	90	85	90
American Light & Traction	99	93	100
American Power & Light 6 per cent	90	84	90
American Public Service 7 per cent	91	88	94
American Public Utilities 7 per cent	88	87	95
American Water Works & Electric 7 per cent	a 99½	99½	103
Associated Gas & Electric 7 per cent—1 per cent extra—50	a 51½	...	...
Associated Gas & Electric—$6—no par	84	...	...
Carolina Power & Light $7—no par	105	100	106
Central Indiana Power 7 per cent	89	88	95
Cities Service 6 per cent	82	80	83
Commonwealth Power 6 per cent	83	80	85½
Continental Gas & Electric 7 per cent pr. pf.	92	89	95
Electric Bond & Share 6 per cent	a104½	103½	105½
General Gas & Electric—$8—no par	130	104½	136
*Middle West Utilities 7 per cent	98½	91½	98½
National Power & Light—$7—no par	100½	95	99
North American 6 per cent—50	a 49½	46½	50½
Public Service Corp. of N. J. 7 per cent	100	99	102½
Public Service Corp. of N. J. 8 per cent	a113	109	114¾
United Light & Power—$6.50—no par	93	83	89
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	81	31	93
Appalachian Power—no par	78	70	83
Arkansas Light & Power	100	65	98
Brooklyn Edison	a134½	120½	140½
Buffalo General Electric—no par (new)	65	44	69
*Commonwealth Edison	139	130½	141½
§Consolidated Gas, Electric Light & Power	41	32	44
Dayton Power & Light	420	180	460
Detroit Edison	a123	110	125¾
|| Edison Electric Illuminating of Boston	211	200	213
Long Island Lighting (new)	90½	85½	92½
Mississippi River Power	58	37	62
Montana Power	a 82½	64	87½
Niagara Falls Power—no par	67	45½	69
Niagara, Lockport & Ontario Power—no par	65	60	73
Northern Ohio Power	10	5	13½
Northern States Power	117	103	123
North Texas Electric	40	40	70
Pacific Gas & Electric	a114½	102½	118½
§Pennsylvania Water & Power	150	126½	152½
‡Philadelphia Electric—25	40	37¾	37¾
Public Service Co. of Northern Illinois	122	97	124
Puget Sound Power & Light	54	49	61
Southern California Edison	118	102	120½
Tennessee Electric Power—no par	67	47	67
Virginia Power	65	65	92
Virginia Railway & Power	a119	64½	123
West Penn. Co.	128½	105	145
Holding Companies			
American Gas & Electric—no par	77	70	85
American Light & Traction	165	139	172
American Power & Light	59	52	67
American Public Utilities	78	70	85
American Water Works & Electric	a 63	34¾	68
Associated Gas & Electric, Class A	a 32½	...	...
Carolina Power & Light	390	290	425
Cities Service (new)	38½	34	43
Columbia Gas & Electric—no par	a 64½	45¾	69¼
Commonwealth Power Corp.—no par	161	106	168
Consolidated Gas—no par	a 87½	74½	89½
Continental Gas & Electric	97	77	90
Electric Bond & Share Securities	a 67½	67	70½
Electric Power & Light	a 36½	17¾	37¼
Federal Light and Traction	a 33½	30	36
General Gas & Electric	175	72	180
Lehigh Power Securities—no par	145	82	131
*Middle West Utilities—no par	93½	82½	102¾
National Power & Light—no par	350	185	352
North American—10	a 48½	41½	50½
Philadelphia Co.—50	a 60½	51½	61½
Power Securities—no par	17	...	...
Public Service Corp. of N. J.—no par	a 68½	62½	74
Standard Gas & Electric—no par	a 52½	40½	54½
United Gas & Electric (Conn.)—no par	46	26	49

BONDS

Operating Companies					
Adirondack Power & Light	6s	1950	105½	102½	105½
Alabama Power	5s	1946	99½	96	100
Appalachian Power	5s	1941	99	96	99½
Brooklyn Edison	5s	1949	101¼	99½	103
	6s	1930	105½	104	105½
Cleveland Electric Illuminating	5s	1939	102	100	102
Commonwealth Edison	5s	1943	102½	99½	102
	5s	1953	100½	98½	101
§Consol. Gas, Elec. Lt. & Pwr.	4½s	1935	97½	93½	97½
	6s	1949	107	104½	107½
Consumers' Power	5s	1936	100½	99	100½
	5s	1952	97½	90½	100
Detroit Edison	5s	1933	101½	99½	102½
Duquesne Light	6s	1949	106	104½	107½
Great Western Power	5s	1946	98½	9-	99
Kansas City Power & Light	5s	1952	99½	95½	101
Mississippi River Power	5s	1951	99½	96½	100
Montana Power	5s	1943	100½	97½	100½
New England Power	5s	1951	102	100½	102
New York Edison	6½s	1941	114½	112	115½
Niagara Falls Power	6s	1932	105½	103½	106½
Northern States Power	5s	1941	98	93	99½
	6s	1941	106	103	107½
Ohio Power	7s	1951	106	106½	107½
Pacific Gas & Electric	5s	1942	97½	93½	99
Pennsylvania Water & Power	5s	1940	101	99½	102
‡Philadelphia Electric	5s	1966	103½	100½	103½
	5½s	1953	106½	104½	107½
	6s	1941	107½	106	108
Portland Electric Power	6s	1947	99½	96½	100
Southern California Edison	5s	1939	100	99½	101
	6s	1944	104½	102½	104½
Tennessee Electric Power	6s	1947	102½	99½	104½
Texas Power & Light	5s	1937	98½	97	99½
Toledo Edison	7s	1941	109½	108½	110
Utah Power & Light	5s	1944	96½	91	98½
Holding Companies					
Alabama Traction, Light & Power	5s	1962	92½	86	95
American Gas & Electric	6s	2014	98	96½	98½
American Power & Light	6s	2016	97	94	98
Amer. Water Works & Electric	5s	1934	95½	92½	98
Associated Gas & Electric	6½s	1954	a102	...	...
Central Indiana Power	6s	1947	98½	95½	98½
Commonwealth Power	6s	1947	102	97½	103½
Consolidated Cities Lt., Pwr. & Tr.	5s	1962	80½	75½	82½
Illinois Power & Light	6s	1953	102	100½	102½
United Light & Railways	5s	1932	96½	93½	97
	6s	1952	100	95½	100½
ELECTRICAL MANUFACTURING COMPANIES					
PREFERRED STOCKS					
Allis-Chalmers Manufacturing			105	103½	108
Worthington Pump & Machinery A			a 77	79	88
COMMON STOCKS					
Allis-Chalmers Manufacturing			a 82	71½	86½
American Bosch Magneto—no par			a 36	26½	54½
Electric Storage Battery—no par			a 63½	60½	70½
General Electric			a289	227½	320
General Electric—10			a 11¾	11	11¾
*Hurley Machine—no par			48	41½	56
†Wagner Electric			37½	26½	50
Westinghouse Electric & Manufacturing—50			a 71½	66½	84
Worthington Pump & Machinery			a 40	36½	79½
BONDS					
General Electric	3½s	1942	85½	83	85
	5s	1952	106½	101½	107
Robbins & Myers	7s	1952	70½	63½	73½
Western Electric	5s	1944	100	98	101
Westinghouse Electric & Mfg	7s	1931	107	106½	108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange §Baltimore Stock Exchange.
a Bid price, low and high, Monday, June 29.

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Printed in the First Issue of Each Volume

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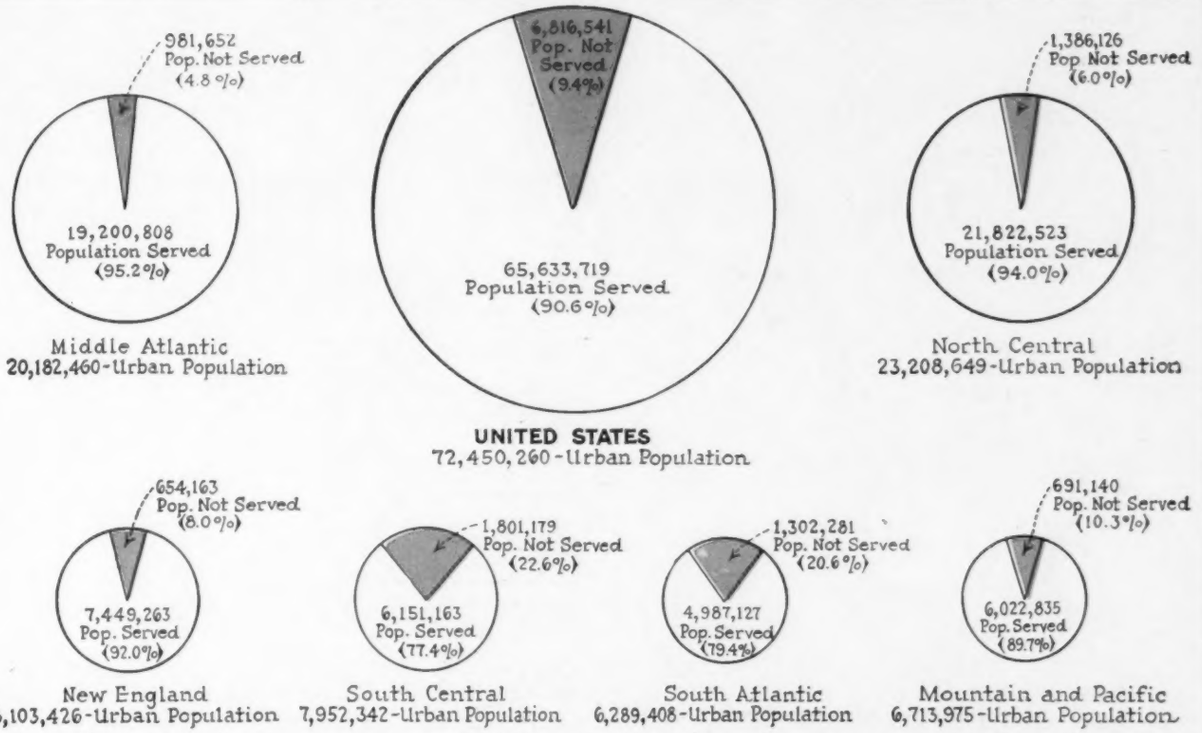
Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business



Population of Cities, Towns and Villages in the United States Served and Not Served by Central-Station Systems

Includes all towns of 250 population and over which have a post office or city postal service

"Coverage"

"COVERAGE" has become a term in modern industry indicative of degree of thoroughness. If a newspaper or publication is read by a very large percentage of the persons possessing potential buying power, then that publication has a high "coverage." If a manufacturer of national proportions has his district offices scientifically located with reference to the potential buying power of the country, then he also has a high "coverage."

"Coverage" likewise is applicable to the activities of the electric light and power industry. Today there are very few towns which are not served with electrical energy either from their local generating plant or from a transmission line passing through the town. This is evidenced by the fact that of a total of 72,450,260 people living in cities or towns of more than 250 inhabitants, 65,633,719, or 90.6 per cent, are living in towns reached by central stations, and only 6,816,541, or 9.4 per cent, are living in towns not at present enjoying the advantages of electrical energy. It must not be assumed, of course, that all these people are living in electrically lighted dwellings. It is very doubtful whether there is a town in the country 100 per cent domestically electrified, and in the larger cities there are localities, especially in the older housing sections, which are not considered as possible of future electrification until such time as the present structures shall be demolished and up-to-date buildings substituted.

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.

A large range in "coverage" by the electric light and power industry is to be found in the various sections of the country. The Middle Atlantic States reports "coverage" of 95.2 per cent, the highest in the country, while the South Central section reports a "coverage" of only 77.4 per cent. All these figures are for July, 1924, however, and it is very probable that when the figures for the present year are available the sections with a comparatively low "coverage" will report a much improved condition. There are some states, especially in the West, which report virtually 100 per cent "coverage" of towns over 250 inhabitants.

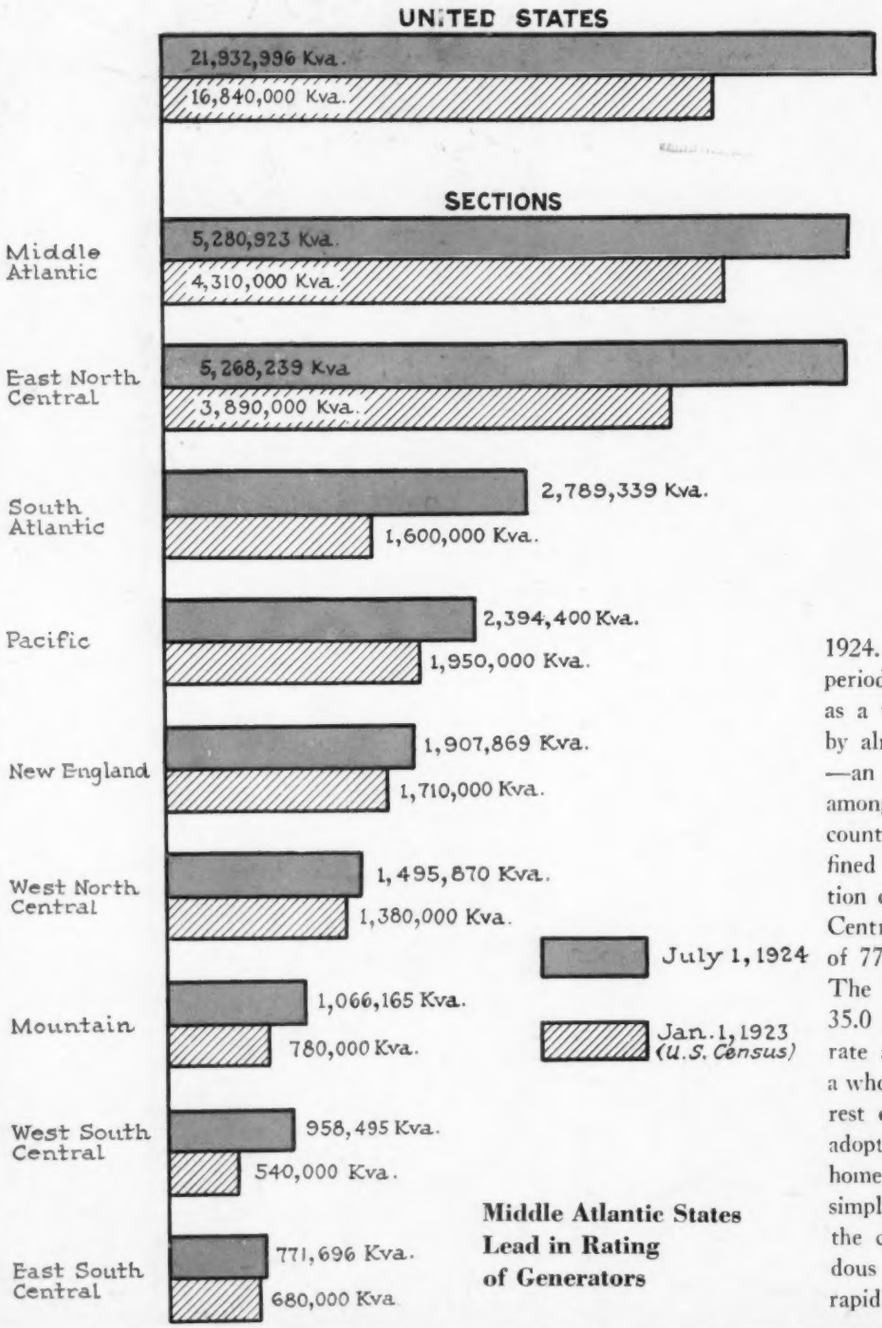
Practically all new construction today is electrically equipped in any town reached by central-station service, and the newness of the West has a great deal to do with the high percentage of people who are living in electrically lighted dwellings.

Generator Rating and Growth

THERE are many indicators of growth in the operations of the electric light and power industry. The annual increases in capitalization tell of the monetary requirements of the industry for building new generating plants, extending transmission and distribution systems and erecting new administrative quarters. The gross revenue tells of the growth in high-revenue and low-revenue customers and, taken in conjunction with the operating expenses of the industry, declares the dividends which are available to the hungry stockholders. Other fundamental data, such as those on output, number of customers, employees, merchandise sales, etc., tell respectively of various phases of central-station activity, and when taken in the aggregate these data form a composite picture of the electric light and power industry as it exists today.

But there is one class of data which tells the whole story within itself. The entire operations of the industry are reflected most accurately in the rating of the generators which are installed in the central stations of the country. Transmission and distribution extensions, new administration quarters, output, revenue, customers, etc., are all dependent upon the machine which manufactures the electrical energy. Eliminate the generator from the industry and the industry would cease to exist.

It is perfectly correct, herefore, to assume that the data shown on the accompanying diagram on the generator rating of the country present an accurate picture of the growth of the electric light and power industry during the period from January, 1923, to July, 1924. During this eighteen-month period the industry in the country as a whole increased its operations by almost one-third—30.2 per cent—an achievement without parallel among the primary industries of the country. Nor was this increase confined to any one region. One section of the nation, the West South Central States, reported an increase of 77.5 per cent during this period. The South Atlantic States, with 35.0 per cent, also developed at a rate above that for the country as a whole. The South was behind the rest of the country in the original adoption of electrical energy into the home and factory, and the South is simply catching up with the rest of the country today. It has tremendous resources and is advancing with rapid strides.



Middle Atlantic States Lead in Rating of Generators